Mark Schubin's

High Definition Glossary

A special editorial supplement to VIDEOGRAPHY magazine.
Sponsored by The HDTV 1125/60 Group

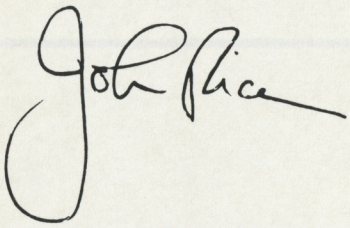
The origins of Mark Schubin's High Definition Glossary go back many months to a casual discussion about the new "language" that is developing around the technology. That conversation resulted in this glossary, by far the largest and most comprehensive work that Mark has done for this magazine in his and its history.

That is not an idle comment as Mark Schubin has contributed over 200 pieces to the pages of this magazine in its twelve and a half year history beginning with the premiere issue and every month to date.

About half way through the process of creating this glossary, the HDTV 1125/60 Group came into formation. The initial purpose of Mark's work and the goals of the group were too similar. We told the group about Mark's effort and it became the third part of this suppliment.

What you have here is something unique. It is a fully sponsored editorial insert that could have only come about through Mark Schubin's work and the HDTV 1125/60 Group's involvement.

We think it is an exciting and valuable piece and are proud to bring it to the industry.



John Rice
Publisher & Editorial Director

Earlier this summer a number of manufacturers of production equipment for high definition television (HDTV) program production formed an organization to support the application of the ATSC/SMPTE 1125/60 HDTV production standard. That organization is now known as the HDTV 1125/60 Group.

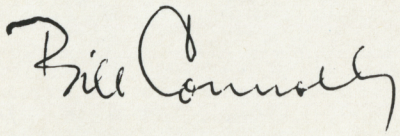
Among the goals of this organization is the group's desire to provide accurate information on the HDTV 1125/60 production standard to the many technical and non-technical groups currently studying the broad aspects of advanced television systems. With the current wide range of industry interest in HDTV studio origination, transmission and program distribution, confusion exists over the issues and terminology. We seek to demystify and clarify these issues and terms.

When the HDTV 1125/60 Group and VIDEOGRAPHY began discussing the idea of publishing Mark Schubin's High Definition Glossary, we saw it as a sorely needed information piece that would be useful to all industry interests, helping to move forward these exciting advances in electronic imaging.

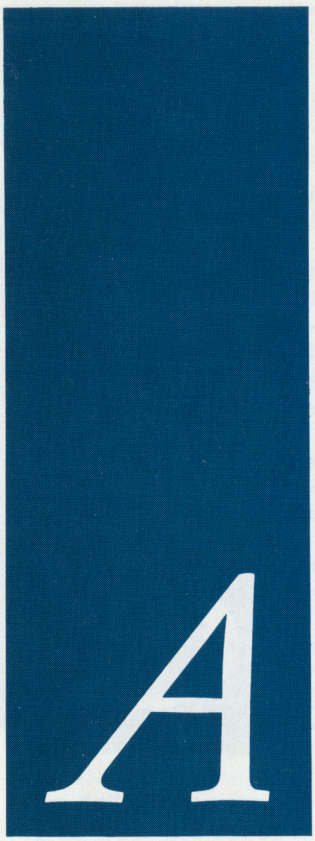
Mark has done a superb job in compiling this comprehensive list of HDTV acronyms and terminology. We view his work as a significant contribution to understanding and appreciating all ATV-related technology.

As an organization, the HDTV 1125/60 Group aims to enhance U.S. program production and manufacturing opportunities by actively supporting the ATSC/SMPTE 1125/60 production standard for studio origination and program exchange. We hope to provide an industry forum for the exchange of ideas between users and manufacturers that can help guide future product development, and to assist the industry at large in appreciating the many advantages to be realized by a single HDTV production standard.

Although the Group's focus is on HDTV program production and equipment manufacturing, we support the efforts of all those who are currently seeking technical solutions to transmission and distribution issues relating to Advanced Television Systems. We hope that our sponsorship here makes a positive contribution to these efforts.



Bill Connolly
Technical Spokesman
HDTV 1125/60 Group



A Advanced.

ABC Television network financially supporting development of ACTV and pioneering the use of digital video transmission.

ACATS The FCC's Advisory Committee on Advanced Television Service, a group comprised almost exclusively of presidents, chief executive officers, and chairs of the boards of major broadcasting, CATV, consumer electronics, and entertainment production companies. It is currently supported by a planning subcommittee (with two advisory groups and six working parties), a systems subcommittee (with four working parties), and an implementation subcommittee (with two working parties).

ACLE Analog component link equipment. A form of MAC optimized for remote broadcasting links.

Active Line Time The duration of a scanning line minus that period devoted to the horizontal blanking interval.

Active Lines The total number of scanning lines minus those scanning lines devoted to the vertical blanking interval.

ACTV Advanced Compatible Television, techniques for ATV transmission developed by the DSRC, with support initially from NBC and RCA/GE Consumer Electronics (now Thomson Consumer Electronics) and with later support from such organizations as ABC and HBO. There are two ACTVs. ACTV I is a channel-compatible, receiver-compatible system utilizing many different techniques to add widescreen panels and increase horizontal and vertical resolution (see reference 27). Among the techniques are the filling of a Fukinuki hole, time compression, seam-elimination, spatio-temporal filtering, and quadrature modulation of the picture carrier. The last prevents direct compatibility with videotape recorders and with ordinary satellite transmission techniques. ACTV II is ACTV I plus an augmentation channel to improve resolution and sound.

Acuity See Visual Acuity.

Adaptive Changing according to conditions.

Adaptive Emphasis An ATV technique for improving detail of dark parts of the picture by increasing their level. If a complementary de-emphasis is performed at the receiver, noise can be reduced. Dolby B noise reduction (the form of Dolby noise reduction most common in consumer cassette recorders) is a classic example of complementary adaptive emphasis.

Adaptor A device that allows an ordinary NTSC television set to receive pictures from a non-receiver-compatible ATV system.

ADC Analog-to-digital converter.

Adjacent Channel A television transmission channel immediately adjacent to an existing channel. For example, channel 3 is adjacent to channels 2 and 4. There are three exceptions to what might otherwise be considered adjacent channels: There is a small gap between channels 4 and 5; there is a large gap between channels 6 and 7; and there is an enormous gap between channels 13 and 14. Adjacent channels figure into ATV in two ways. First, it is currently illegal to broadcast on adjacent channels in a single location. Some ATV proponents feel that augmentation channels might someday be allowed to be placed in adjacent channels. If half-size (3 MHz) or smaller augmentation channels are used, all current broadcasters could then be allowed an augmentation channel. Some proponents feel the use of a low power digital augmentation channel will allow adjacent channels to be used without interference. Second, some ATV proposals require that the augmentation channel be adjacent to the transmission channel or require a larger than normal transmission channel, thus occupying a channel and one of its adjacent channels.

ADPCM Adaptive differential pulse code modulation. A technique for compressing the transmission requirements of digital signals. ADPCM has been used by ABC between New York and Washington to allow NTSC transmission on a 45 Mbps (DS3) telephone company data transmission circuit.

ADTV Advanced Definition Television, a term sometimes used for both EDTV and HDTV.

Advanced Encoder A device that changes RGB or CAV into NTSC utilizing some form or forms of prefiltering to reduce or eliminate NTSC artifacts. Some advanced encoders also offer image enhancement, gamma correction, and the like.

AEA American Electronics Association. An organization of manufacturers more associated with computers and communications than is the EIA. The AEA has established an ATV Task Force, the members of which include AT&T, Apple Computer, Hewlett-Packard, IBM, and Motorola.

Alias Something other than what it appears to be. Stairsteps on what should be a smooth diagonal line are an example of a spatial alias. Wagon wheels appearing to move backwards are an example of a temporal alias. Aliases are caused by sampling and can be reduced or eliminated by prefiltering, which can appear to be a blurring effect (see reference 20).

AM Amplitude modulation. A form of modulation where the level of the baseband information affects the level of the carrier.

A-MAC A MAC with audio and data frequency multiplexed before modulation. See also MAC.

American Television and Communications See ATC.

Amplitude Modulation See AM.

Table I: COMPATIBILITY

A. ATV Receiver-Compatibility Levels
Based on Robert Hopkins' "Advanced Television Systems," February 1988 (see "Summertime Blues," VIDEOGRAPHY, August 1988)

- Level 5—ATV signal is displayed as ATV on an NTSC TV set
- Level 4—ATV signal appears as highest quality NTSC on an NTSC TV set
- Level 3—ATV signal appears as reduced quality NTSC on an NTSC TV set
- Level 2—ATV signal requires inexpensive adaptor for an NTSC TV set
- Level 1—ATV signal requires expensive adaptor for an NTSC TV set
- Level 0—ATV signal cannot be displayed on an NTSC TV set

B. Compatible ATV Transmission Schemes:
- Receiver-compatible and channel-compatible single 6 MHz channel
- Receiver-compatible channel plus augmentation channel
  - Necessarily adjacent augmentation channel
  - Not necessarily adjacent augmentation channel
- Non-receiver-compatible channel plus simulcast channel

Note: For the purposes of Table I-B, the term "receiver-compatible" includes levels 3 to 5 of Table I-A.

AM-VSB Amplitude modulation with vestigial side band. The form of modulation used in broadcast and cable television transmission. It is more efficient than dual-sideband amplitude modulation and is easier to implement than single-sideband amplitude modulation.

Analog (Analogue) a signal that is an analogy of a physical process and is continuously variable, rather than discrete. See also Digitization.

Anamorphic Squeeze A change in picture geometry to compress one direction (usually the horizontal) more than the other. Anamorphic squeeze lenses made CinemaScope possible. Occasionally, when widescreen movies are transferred to video, an anamorphic squeeze will be used (usually only in credits) to allow the smaller aspect ratio of television to accommodate the larger movie aspect ratio. Some ATV proponents have suggested a gentle anamorphic squeeze as a technique to assist in aspect ratio accommodation.

ANSI American National Standards Institute, which may soon standardize the SMPTE HDEP proposal.

Aperture As applied to ATV, the finite size and shape of the point of the electron beam in a camera or picture tube. As the beam does not come to an infinitestimal point, it affects the area around it, reducing resolution.

Aperture Correction Signal processing that compensates for a loss of detail caused by the aperture. It is a form of image enhancement adding artificial sharpness and has been used for many years.

Artifacts Visible (or audible) consequences of various television processes. Artifacts are usually referred to only when they are considered defects. Artifact elimination is often more apparent than quality increases such as resolution enhancement. See also Filter Artifacts, Impairments, and NTSC Artifacts.

Aspect Ratio Ratio of the width of an image to its height, sometimes expressed as two numbers separated by a colon (e.g., 4:3) or sometimes as one number, with a colon and the number one implied (e.g., 1.85 is the same as 1.85:1). Aspect ratios of ATV systems are sometimes expressed relative to nine (e.g., 16:9, 15:9, 14:9, and 12:9).

Aspect Ratio Accommodation Techniques by means of which something shot in one aspect ratio can be presented in another. The five currently used or proposed techniques are compared in Table II: Aspect Ratio Accommodation. It is also possible to combine techniques. Current ATV aspect ratio debates concentrate on the problems of presenting widescreen images to existing TV sets; the same problems (in an opposite direction) will occur when current aspect ratio images are presented on widescreen TV sets. In movie theatres these problems are usually solved with movable drapes.

ATC American Television and Communications. Time Inc.'s CATV multiple system operator (MSO), a co-proposer with HBO of C-HDTV and a supporter of ACTV.

AT&T Consumer electronics manufacturer and long distance telephone, television, and data carrier. Its Bell Labs has worked on the development of ATV systems.

ATRP Advanced Television Research Program at MIT.

ATSC Advanced Television Systems Committee. A sort of NTSC for ATV (see reference 14). It is comprised of three technology groups and a number of smaller committees. The T1 technology group is studying receiver-compatible improved NTSC; the T2 group is studying non-receiver-compatible 525 scanning line production, distribution, and display systems; and the T3 group is studying HDTV. See also JCIC.

ATTC Advanced Television Test Center. Created by seven broadcasting organizations to test different broadcast ATV systems. See also Cable Labs.

ATT-C AT&T Communications. The long distance arm of AT&T.

ATV Advanced television. Television better than what is currently broadcast. It includes HDTV, EDTV, IDTV, and artifact elimination schemes.

Augmentation Channel A transmission channel carrying information that can augment that being transmitted in an ordinary transmission channel such that a special television set that can receive both channels can get pictures better than those available from the main channel alone. Some ATV schemes require the augmentation channel to be adjacent to the main channel. Others can theoretically accept a non-adjacent augmentation channel, though, at the time of this writing, the acceptability of non-adjacent channels has not been proven to everyone's satisfaction.

A-Vision An ATV system proponent.

B

Baby Bell A term commonly used for one of the seven regional holding companies extablished when AT&T divested itself of its local telephone companies. The Baby Bells are: Americom, Bell Atlantic, Bell South, Nynex, Pacific Telesis, Southwestern Bell, and US West.

Bandwidth A measure of information capacity in the frequency domain. The greater the bandwidth of a transmission channel, the more information it can carry. In television, bandwidth is usually expressed in MHz.

Bandwidth Efficient Phrase sometimes used to describe techniques to carry the maximum amount of picture information within a prescribed bandwidth; also, name applied to one MIT ATV proposal that would transmit only the spatio-temporal resolution necessary for a particular scene. For example, it would transmit no more than 24 frames per second when showing a movie shot at that rate.

Baseband Not modulated.

Base Bandwidth The amount of bandwidth required by an unmodulated signal, such as video or audio. In general, the higher the quality of the signal, the greater the base bandwidth it requires.

Bellcore See Bell Labs.

Bell Labs Originally Bell Telephone Laboratories, the research arm of the Bell System. When AT&T divested itself of its regional telephone companies, Bell Labs was split. One division, still called Bell Labs, belongs to AT&T and is a proponent of a particular ATV system (SLSC). The other division, called Bell Communications Research, or Bellcore for short, belongs to the Bell regional holding companies (RHCs) and is, among many other R&D projects, investigating mechanisms for reducing the bit rate of digital video transmission, which may be applicable to ATV. Bellcore has formed a joint venture with NHK for HDTV research.

Bezel The frame that covers the edge of the picture tube in some TV sets and can therefore hide edge information transmitted in an ATV system (such as ACTV I) not meant for the viewer to see. See also Overscanning.

B-ISDN A mechanism by means of which telephone companies will be able to carry television signals (and, probably, ATV signals) digitally, probably via optical fibers. ISDN systems are considered broadband if they carry at least 45 Mbps, the DS3 rate, currently used for delivery of broadcast television signals. If and when B-ISDN reaches homes it will be a powerful competitor to other delivery mechanisms, potentially able to perform a computer-television function.

Bit Rate The digital equivalent of bandwidth.

Bit Rate Reduction Schemes for compressing high bit rate signals into channels with much lower bit rates.

Blanking A video signal level below which no light should be emitted from a TV screen (the level at which the screen is blanked); also, that portion of the time that a video signal is transmitted when it is at or below blanking. These time portions can be divided into a horizontal blanking interval (HBI) and a vertical blanking interval (VBI). Since no picture information is carried in either blanking interval in an NTSC signal, various ATV schemes propose using them for carrying augmentation information, such as higher quality sound or widescreen panel information. Potentially conflicting with those schemes are other schemes that already use the blanking intervals for descrambling codes, text transmission, time code, and test and reference signals. See also True NTSC. Reducing the duration of the blanking intervals to allow more picture information to be transmitted potentially conflicts with the demands of the scanning circuitry of older TV sets. Sometimes this conflict is said to be resolved by bezel coverage and overscanning.

Blanking Adjustment A technique proposed in some ATV schemes to increase the VBI (and, sometimes, decrease the HBI) to deal with wide aspect ratios. See also Burn.

Blanking Stuffing An ATV technique that adds information to blanking areas that is supposed to be invisible to ordinary sets but can be used by an ATV set for increased resolution and/or widescreen panels.

Blue Aging A tendency for blue phosphors to age more rapidly than red or green. See also Phosphor Aging.

Blur A state of reduced resolution. Blur can be a picture defect, as when a photograph is indistinct because it was shot out of focus or the camera was moved during exposure. Blur can also be a picture improvement, as when an unnaturally jagged-edged diagonal line or jerky motion is blurred to smoothness (see reference 20).

B-MAC A MAC with audio and data time multiplexed before modulation, which forms the basis for the HDB-MAC ATV scheme, currently used for satellite transmission and scrambling in the United States. See also MAC.

BOC Bell operating company. A local telephone company formerly owned by AT&T.

Broadcast Television Conventional terrestrial television broadcasting, the most technically constrained delivery mechanism for ATV, faced with federal regulations and such potential problems as multipath distortion and co-channel interference.

BTA Japan's Broadcast Technology Association. A national standards-making organization comprising manufacturers and broadcasters, not unlike SMPTE. A proponent of an ATV system.

BTS Broadcast Television Systems. A joint venture of Bosch Fernseh and Philips established to sell television production equipment. BTS offered the first multi-standard HDTV camera.

Burn An image or pattern appearing so regularly on the screen of a picture tube that it ages the phosphors and remains as a ghost image even when other images are supposed to be shown. On computer terminals, the areas occupied by characters are frequently burned, particularly in the upper left corner. In television transmission centers, color bars are sometimes burned onto monitors. There is some concern that some ATV schemes will burn a widescreen pattern on ordinary TV sets due to increased vertical blanking or will burn a non-widescreen pattern on ATV sets due to reception of non-ATV signals (see reference 30). In production, refers to long-term or permanent image retention of camera pickup tubes when subjected to excessive highlights.

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C

C Chrominance; also compatible.

Cable Labs Cable Television Laboratories Inc. An ATV research and development center funded by U.S. cable television organizations.

Capitol Centre An ATV proponent.

Carrier An electromagnetic wave modulated with information to be recorded or transmitted; also a term used for such organizations as telephone companies, who carry signals from place to place. See also Modulation.

CATS Center for Advanced Television Studies (see reference 14).

CATV Community antenna television or cable television. A delivery mechanism for ATV not necessarily as technically constrained as broadcast television.

CAV Component analog video. Refers to the handling of unencoded color signals (separate components), a form of signal recording and distribution not subject to cross-color and cross-luminance artifacts and offering potentially greater chroma resolution. When used to ultimately feed NTSC receivers, CAV signals must pass through an NTSC encoder, but, as that might be the only encoder used in production or postproduction, it can be an advanced encoder (see reference 29).

CBS Television network that was the first major U.S. proponent of ATV, organized the first major U.S. demonstrations of ATV, made the first request to the FCC for ATV transmission, developed advanced encoders and decoders, and developed the first ATV transmission scheme (TMC) that proved that widescreen panels could be transmitted separately from the center of the picture and be attached without visible seams in an ATV set. Long a proponent of NHK work, CBS is the only U.S. commercial network not currently supporting ACTV research.

CCETT French acronym for the French Joint Research Center for Television and Telecommunications, a proponent of the French proposals for a U.S. ATV system.

CCF Chroma crawl free. A term for several HRS-developed ATV schemes designed to eliminate some NTSC artifacts. In CCF I, one half-cycle of the color subcarrier is dropped in every scanning line except the last one in a field. This may be accomplished by feeding special CCF I synchronizing signals to a color television camera or by using a very simple form of standards converter. In either case, the CCF I signal eliminates the moving dots of cross-luminance and allows human vision to eliminate cross-color in stationary images and some moving images. It changes the NTSC frame rate to 60.07, however. For that and other reasons, it may not currently be legally broadcast, though it is channel-compatible and receiver-compatible. CCF II maintains the NTSC frame rate of 59.94 at the loss of cross-color elimination by adding half a cycle of color subcarrier in one frame and subtracting it in the next. Some television production equipment would not be able to tolerate CCF signals without modification. The CCF schemes are incompatible with most receiver comb filters.

CCIR French acronym for the International Radio Consultative Committee. An international television standardization organization. The CCIR has deferred action on a U.S.- and Japan-sponsored proposal to establish a worldwide standard for HDEP based on the SMPTE system for an additional four-year cycle (to 1990). It has, however, adopted a worldwide standard for component digital video. See also Recommendation 601.

CCITT French acronym for the International Telephone and Telegraph Consultative Committee. An international standardization organization dealing with such issues as B-ISDN.

CD Compact disc. The audio quality some ATV proponents feel is the minimum performance level acceptable for ATV. Others feel CD quality might be excessive (see reference 17).

CDL Central Dynamics, Limited.

Central Dynamics, Limited Well-known Canadian manufacturer of television production equipment, first manufacturer to announce a line of two-dimensional pre-combing encoders and complementary decoders for analog and digital NTSC and component formats.

Table II: ASPECT RATIO ACCOMMODATION

	Blanking Adjustment	Truncation	Pan and Scan	Anamorphic Squeeze	Shoot and Protect
Maintains Director's Intent	Y	N	N	S	Y
Utilizes Full Screen (No Burn)	N	Y	Y	Y	Y
Displays All Action	Y	N	S	Y	Y
Maintains Picture Geometry	Y	Y	Y	N	Y
Automatic Conversion Possible	Y	Y	N	Y	Y
Full Production Freedom	Y	Y	Y	Y	N

Y=Yes N=No S=Somewhat

Note that it is possible to combine systems (say, a mild anamorphic squeeze in conjunction with blanking adjustment and mild pan and scan) to reduce disadvantages.

CES Consumer Electronics Show. A semi-annual event sponsored by the Consumer Electronics Group of the EIA, at which IDTV and HDTV schemes have been demonstrated (see reference 30).

Channel-Compatible An ATV transmission scheme that will fit within the confines of a standard, 6 MHz NTSC transmission channel. A higher level of channel-compatibility demands NTSC-like AM-VSB transmission so that the ATV channel will not cause any interference to other channels that would not otherwise be caused by an NTSC channel. Channel-compatible ATV schemes need not necessarily also be receiver-compatible.

Channel Stuffing Techniques for adding information to an NTSC channel without increasing its bandwidth or eliminating its receiver-compatibility. See Table V.

Characteristic An aspect or parameter of a particular television system that is different from another system's, but is not necessarily a defect. Characteristics include aspect ratio, colorimetry, resolution, and sound bandwidth.

C-HDTV Cable HDTV. A seemingly impossible concept calling for channel-compatible ATV transmission of 850 lines of both static and dynamic horizontal and vertical resolution, among other characteristics. Its feasibility is being studied at ATRP.

Chroma Short for chrominance.

Chroma Crawl An NTSC artifact also sometimes referred to as moving dots, a crawling of the edges of saturated colors in an NTSC picture. Chroma crawl is a form of cross-luminance, a result of a television set decoding color information as high-detail luminance information (dots). Most ATV schemes seek to eliminate or reduce chroma crawl, possibly because it is so immediately apparent.

Chroma-Key See Electronic Matting.

Chroma Resolution The amount of color detail available in a television system, separate from any brightness detail. In almost all television schemes, chroma resolution is lower than luminance resolution, matching visual acuity. Horizontal chroma resolution is only about 12 percent of luminance resolution in NTSC; in advanced schemes it is usually 50 percent. See also Resolution.

Chrominance Color information signal or signals.

CIE French acronym for the International Illumination Commission. An international standardization organization that created the chromaticity diagrams (color charts) used to define the colorimetry of all television systems.

CinemaScope The first modern widescreen movie format, achieving a 2.35:1 aspect ratio through the use of a 2:1 anamorphic squeeze (see reference 23).

C-MAC A MAC with audio and data time multiplexed after modulation, specified for some European DBS. See also MAC.

CMTT French acronym for the Mixed Telephone and Television Committee, an international standardization committee concerned with such issues as B-ISDN.

Co-Channel Interference Interference caused by two or more television broadcast stations utilizing the same transmission channel in different cities. It is a form of interference that affects only broadcast television.

Codec Coder/decoder.

Coder Short for encoder.

Colorimetry Characteristics of color reproduction including the range of colors that a television system can reproduce. Some ATV schemes call for substantially different colorimetry (with a greater range) than NTSC's.

Color Subcarrier A sub-channel created by the second NTSC to carry color information within the original NTSC's black-and-white signal with minimal interference to black-and-white sets. The color subcarrier, an interlaced carrier at 3.579545 MHz, is quadrature modulated with a wideband (I) and a narrowband (Q) signal. Unlike currently proposed sub-channels, the original color subcarrier and its hole were not pre-filtered, causing cross-color and cross-luminance artifacts.

Comb Filter A filter designed to deal with periodic signals (signals that are repetitive), such as scanning lines or frames. Comb filters are so named because a chart of their effect on a signal appears similar to the teeth of a comb. They are most often used to separate luminance and chrominance signals in NTSC. Depending on their implementation, comb filters can change moving dots to hanging dots and can reduce vertical and diagonal resolution. Comb filters tend to be incompatible with CCF.

Compatible Video Consortium An organization established by Cox Enterprises and Tribune Broadcasting, which together own 14 television stations, 24 CATV systems, and two production companies. The CVC, which is open to other organizations, was created to support ATV research and is currently supporting Del Rey's HD-NTSC system.

Compatibility A complex concept regarding how well ATV schemes work with existing television receivers, transmission channels, home video equipment, and professional production equipment. See also Channel-compatible, Receiver-compatible, and Table I: Compatibility.

Component A television system in which chrominance and luminance are distributed separately (see reference 29); one of the signals of such a television system; or one of the signals that comprise an ATV system (e.g., the widescreen panels component).

Composite A television system in which chrominance and luminance are combined into a single signal, as they are in NTSC (see reference 29); any single signal comprised of several components.

Computer Television Name of a Time Inc. pay-TV company that pre-dated HBO; also an unrealized concept created by Paul Klein, the company's founder, that would allow viewers access to a vast selection of television programming with no temporal restrictions, in the same way that telephone subscribers can now call any number at any time. B-ISDN might offer the key to the transmission problems of computer television; the random-access library-storage problems remain.

Constant Luminance Principle A rule of composite color television that any change in color not accompanied by a change in brightness should not have any effect on the brightness of the image displayed on a picture tube. The constant luminance principle is generally violated by existing NTSC encoders and decoders (see reference 31). See also Gamma.

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D

D Definition.

DAC Digital-to-analog converter.

DATV Digitally assisted television, an ATV scheme first proposed in Britain.

DBS Direct broadcast satellite. A distribution scheme involving transmission of signals directly from satellites to homes. It does not carry the burden of terrestrial broadcasting's restricted bandwidth and regulations and so is thought by many to be an ideal mechanism for the introduction of high base bandwidth ATV. DBS is the most effective delivery mechanism for reaching most rural areas; it is relatively poor in urban areas and in mountainous terrain, particularly in the north. Depending on frequency band used, it can be affected by factors such as rain.

DCT Discrete cosine transform. A mechanism for bit rate reduction.

Decoders Devices that change NTSC signals into component signals; sometimes devices that change digital signals to analog (see DAC). All color TV sets must include an NTSC decoder. Because sets are so inexpensive, such decoders are often quite rudimentary.

Definition Primarily resolution, though some use the term to mean quality.

Del Rey Group Proponent of the HD-NTSC ATV scheme.

Delivery Getting television signals to a viewer. Delivery might be physical (e.g., cassette or disc) or electronic (e.g., broadcast, CATV, DBS, optical fiber).

Detail Resolution. Finer detail means higher resolution.

Diagonal Resolution Amount of detail that can be perceived in a diagonal direction. Although diagonal resolution is a consequence of horizontal and vertical resolution, it is not automatically equivalent to them. In fact, ordinary television systems usually provide about 40 percent more diagonal resolution than horizontal or vertical. Many ATV schemes intentionally sacrifice diagonal resolution in favor of some other characteristic (such as improved horizontal or vertical resolution) on the theory that human vision is less sensitive to diagonal resolution than to horizontal or vertical. There is some evidence that diagonal resolution could be reduced to about 40 percent less than either horizontal or vertical (overall half of its NTSC value) with no perceptible impairment. See also Resolution.

Digital Expressable numerically. See also Digitization.

Digitization The process of changing an electronic signal that is an analogy (analog) of a physical process such as vision or hearing into a discrete numerical form. Digitization is subdivided into the processes of sampling the analog signal at a moment in time, quantizing the sample (assigning it a numerical level), and coding the number in binary form (see "Numbers, Please," VIDEOGRAPHY, June 1988). The advantages of digitization include improved transmission; the disadvantages include a higher bit rate than the analog bandwidth. Bit rate reduction schemes work to reduce that disadvantage.

DigiVision A company with an early line-doubling ATV scheme.

Direct-View A CRT watched directly, as opposed to one projecting its image on a screen.

Display The ultimate image presented to a viewer; the process of presenting that image.

Distribution The process of getting a television signal from point to point; also the process of getting a television signal from the point at which it was last processed to the viewer. See also Contribution.

D-MAC Originally, a MAC with audio and data frequency multiplexed after modulation, currently a term used in Europe to describe a family of B-MAC-like signals, one of which is the British choice for DBS. See also MAC.

Dot Crawl See Chroma Crawl.

Dot Pitch The distance between phosphor dots in a tri-color, direct-view CRT. It can be the ultimate determinant of resolution.

DPCM See ADPCM.

DSRC David Sarnoff Research Center, formerly RCA Laboratories (now part of SRI International), home of the ACTV research.

DSSB Dual single side band, a modulation technique that might be applied to two of the components of ACTV.

DS3 Digital service 3, one of a hierarchy of North American data transmission rates associated with ISDN and B-ISDN, 44.736 Mbps.

D2-MAC Similar to D-MAC, the form preferred by manufacturers for European DBS. See also MAC.

Dynamic Resolution The amount of spatial resolution available in moving pictures. In most television schemes, dynamic resolution is considerably less than static resolution. See also Motion Surprise, Spatial Resolution, and Temporal Resolution.

Contribution A form of signal transmission where the destination is not the ultimate viewer and where processing (such as electronic matting) is likely to be applied to the signal before it reaches the ultimate viewer. Contribution demands higher signal quality than does distribution because of the processing.

Crawl An appearance of motion in an image where there should be none. See also Chroma Crawl and Line Crawl.

Cross-Color An NTSC artifact occuring when fine detail luminance is displayed by a TV set as chrominance, resulting in a colorful moire pattern where there should be none. Most ATV schemes seek to eliminate or reduce cross-color, perhaps because it is so immediately apparent.

Cross-Luminance NTSC artifacts resulting from the interpretation of chrominance as fine detail luminance in a TV set. The most objectionable form of cross-luminance is chroma crawl or moving dots. Other forms are hanging dots and visible subcarrier. Most ATV schemes seek to eliminate or reduce cross-luminance, perhaps because it is so immediately apparent.

CRT Cathode ray tube or picture tube (CRTs are also used as camera tubes). There are three forms of display CRTs in color television: tricolor (a color picture tube), monochrome (black and white), and single color (red, green, or blue, used in projection television systems). Many widescreen ATV schemes would require a different shape CRT, particularly for direct-view systems.

CVC see Compatible Video Consortium.

E

E Enhanced or extended.

EBR See Electron Beam Recording.

ED-Beta Extended definition Betamax. A consumer/professional videocassette format developed by Sony offering 500-line horizontal resolution and Y/C connections (see reference 26).

Edge A boundary in an image. The apparent sharpness of edges can be increased without increasing resolution. See also Sharpness.

EDTV Extended or enhanced definition television. A form of ATV generally accepted to involve advanced encoding and/or transmission techniques but having less resolution than HDTV. Also sometimes called EQTV. The line between EDTV and HDTV is the minimum performance level, and it is very blurred. In Japan, first generation EDTV transmission has just begun (some confuse this with HDTV transmission). First generation EDTV, fully compatible with existing TV sets and transmissions, includes pre-filtering, sharpness enhancement, gamma correction, receiver line-doubling, improved receiver color decoding, and, possibly, ghost cancelling. Second generation EDTV, while still maintaining receiver-compatibility, might add a wider aspect ratio, and higher resolution (as in ACTV), and better sound.

EIA The Electronics Industries Association. A trade organization that has created recommended standards for television systems (and other electronic products), including industrial television systems with up to 1,225 scanning lines. EIA RS-170A is the current standard for NTSC studio equipment. The EIA is a charter member of ATSC.

Electron Beam Recording A technique for converting television images to film using direct stimulation of film emulsion by a very fine long focal length electronic beam.

Electronic Cinematography Photographing motion pictures with television equipment. Electronic cinematography is often used as a term indicating that the ultimate product will be seen on a motion picture screen, rather than a television screen (see reference 19). See also HDEP and Mathias.

Electronic Matting The process of electronically creating a composite image by replacing portions of one image with another. One common, if rudimentary, form of this process is chroma-keying, where a particular color in the foreground scene (usually blue) is replaced by the background scene. Electronic matting is commonly used to create composite images where actors appear to be in places other than where they are being shot. It generally requires more chroma resolution than vision does, causing contribution schemes to be different than distribution schemes. While there is a great deal of debate about the value of ATV to viewers, there does not appear to be any dispute that HDEP can perform matting faster and better than almost any other moving image medium.

Emphasis A boost in signal level that varies with frequency, usually used to improve SNR in FM transmission and recording systems (wherein noise increases with frequency) by applying a pre-emphasis before transmission and a complementary de-emphasis at the receiver. See also Adaptive Emphasis.

Encoders Devices that change component signals to composite signals; sometimes devices that change analog signals to digital (see ADC). All NTSC cameras include an encoder. Because many of these cameras are inexpensive, their encoders omit many of the advanced techniques that can improve NTSC. CAV facilities can use a single, advanced encoder prior to creating a final NTSC signal.

Encryption Scrambling, considered important for signal security and pay-TV.

ENTSC Philips ATV scheme now called HDNTSC.

E-NTSC A loosely applied term for receiver-compatible EDTV, used by CDL to describe its Prism 1 advanced encoder/decoder family.

Envelope Detector A form of device in a television set that begins the process of converting a broadcast or CATV television signal into a video signal that can be displayed. Envelope detectors are sensitive to some of the modifications to television signals that have been proposed for receiver-compatible ATV systems.

EQTV Enhanced quality television. See EDTV.

Eureka A massive European research effort, sometimes called the European version of Star Wars, embracing many separate R&D projects, including semiconductors, telecommunications, and computers. The Eureka EU-95 project is about ATV systems for 625 scanning line/50 field per second countries.

Europe A geographic region that led the opposition to the ATSC proposal when it was presented to the CCIR as a proposed worldwide standard and is developing its own ATV systems. European television currently has 625 scanning lines and 50 fields per second as opposed to NTSC's 525/59.94.

Even Number The number of scanning lines per frame possible in a progressively scanned television system. An interlaced scan system must use an odd number of lines so that sequential fields will be displaced by one scanning line.

Eye Tracking The process by means of which eyes follow a person or object across a television screen. Many ATV techniques take advantage of the fact that human vision cannot simultaneously demand high spatial resolution and high temporal resolution to reduce the amount of spatial resolution transmitted for moving objects. However, when the eyes track such an object, its image is stationary on the retina, and the visual system can demand as much resolution as it would for a truly stationary object. See also Dynamic Resolution.

F

Faroudja Yves Faroudja and Faroudja Laboratories. First to market an advanced NTSC encoder with precombing; proponent of the Super-NTSC ATV system and of a 1050 scanning line (900 active line), progressive scan, 29.97 frame per second, 1.61:1 aspect ratio HDEP system.

FCC Federal Communications Commission, whose rules and regulations constitute mandatory standards for broadcasters, CATV operators, transmission organizations, and others. See also ACATS.

Fiber Optics See Optical Fiber.

Field One complete vertical scan of an image. In a progressive scanning system, all of the scanning lines comprising a frame also comprise a field. In an interlaced scanning system, all of the odd-numbered or all of the even-numbered scanning lines comprise a field, and two sequential fields comprise a frame.

Field Alias An alias caused by interlaced scanning. See also Interlace Artifacts.

Field Rate Number of fields per second.

Filter A device that allows certain parts of signals to pass through and stops others, in the same way that a coffee filter allows water and certain parts of the coffee to pass through while stopping the grounds. Filters are always used in decoders and usually in encoders.

Filter Artifacts Artifacts introduced by filters. The most common visual artifacts introduced by filters are reduced resolution and ringing.

Flicker A rapid visible change in brightness, not part of the original scene. See also Flicker Frequency, Fusion Frequency, Judder, Large-Area Flicker, and Twitter.

Flicker Frequency The minimum rate of change of brightness at which flicker is no longer visible. The flicker frequency increases with brightness and with the amount of the visual field being stimulated. In a recent study, a still image flashed on and off for equal amounts of time was found to have a flicker frequency of 60 flashes per second at a brightness of 40 foot lamberts (fL) and 70 at 500. Television sets generally range around 100 fL in peak brightness (though some new ones claim over 700). The SMPTE recommends 16 fL for movie theatre screens (though this is measured without film, which reduces the actual scene brightness by at least 50 percent). One reason for interlaced scanning is to increase television's flashing pictures to the flicker frequency, without increasing bandwidth.

FM Frequency modulation. The form of modulation used for television sound transmission in most of the world, for satellite video transmission, and for videotape recording.

Frame Rate The number of frames per second.

French Proposals Three HDEP proposals, two closely related, suggested by a number of French organizations. For countries with a field rate of 50, there would be 1,200 scanning lines, 1,150 of them active. For countries with a field rate of 59.94, there would be 1,001 scanning lines, 970 of them active. Both systems would have identical line rates (60,000) and bandwidths (65 MHz luminance), and would be progressively scanned. This correspondence would allow a great deal of common equipment, as Recommendation 601 does for digital component video. The third proposal is for a worldwide standard based on 1,050 scanning lines (970 active), 2:1 interlace, and 100 fields per second.

Frequency Repetition rate. In electronics, almost invariably the number of times a signal changes from positive to negative (or vice versa) per second. Only very simple signals (sine waves) have a single constant frequency; the concept of instantaneous frequency therefore applies to any transition, the frequency said to be the frequency that a sine wave making the same transition would have. Images have spatial frequencies, the number of transitions from dark to light (or vice versa) across an image, or per degree of visual field.

Frequency Allocation Table List of which frequencies can be used for transmission of different signals in the U.S. It may require revision for certain ATV schemes. A similar function is performed internationally by the International Frequency Registration Board (IFRB), like the CCIR, part of the International Telecommunications Union (see "The Spectre of the Spectrum," VIDEOGRAPHY, March 1978).

Frequency Interleaving The process by which color and brightness signals are combined in NTSC.

Frequency Multiplex see Multiplex.

FUCE Fully compatible EDTV. A Hitachi ATV scheme filling a Fukinuki hole for increased luminance detail, with recent proposed additions to increase chroma detail.

Fukinuki Takahiko Fukinuki and the Fukinuki Hole named for him. Fukinuki is a Hitachi researcher who proposed filling an apparently unused portion of the NTSC spatio-temporal spectrum with additional information that might be used for ATV. The signal that fills a Fukinuki hole is sometimes referred to as a Fukinuki subcarrier. It is extremely similar to the color subcarrier and can cause an effect like cross-luminance under certain conditions.

Fusion Frequency The minimum rate of presentation of successive images of a motion picture that allows motion to seem smooth, rather than jerky. The fusion frequency is almost always lower than the flicker frequency. As it applies to the rate at which images are presented, rather than the rate at which they were shot, material that appears to be at or above the fusion frequency when viewed at normal speed may be below it when viewed in slow motion. Techniques to smooth motion presented at a rate below the fusion frequency have been developed for such purposes as computer-assisted animation; these are sometimes called in-betweening techniques. See also Judder.

Gamma A measure of how much a graph of display brightness versus scene brightness varies from a straight line. Picture tubes have gammas of more than one; cameras, therefore, use gammas of less than one so the overall brightness-in/brightness-out characteristic will be linear (a straight line). Unfortunately, current CRT gammas do not match those in the NTSC standard, creating non-linear gamma. Furthermore, since camera gamma is introduced prior to encoding (which lowers chroma resolution), the constant-luminance principle is violated. Several ATV schemes address these points (see reference 31).

Gamma Correction Compensation for gamma problems.

GE General Electric. A proponent of the ACTV schemes.

Geometry The shape of objects in a picture, as opposed to the picture itself (aspect ratio). With good geometry, a picture of a square is square. With poor geometry, a square might be rectangular, trapezoidal, pillow-shaped, or otherwise distorted. Some ATV schemes propose minor adjustments in geometry for aspect ratio accommodation.

Ghosts See Multipath Distortion.

GHz Gigahertz, billions of cycles per second.

Glenn William and Karen Glenn, researchers for NYIT in Dania, Florida, who developed the VISTA ATV scheme. They are often cited for their work indicating that human vision cannot simultaneously perceive high spatial detail and high temporal detail.

Group Delay The delay of certain frequencies relative to others, a common characteristic of filtering. Since color is carried as a high frequency subcarrier in NTSC, group delay can cause color to become shifted relative to brightness, creating a ghost-like effect.

H

H High; also horizontal.

Hanging Dots A form of cross-luminance created by simple comb filters. It appears as a row of dots hanging below the edge of a highly saturated color. See also Cross-Luminance.

HARP High-gain avalanche rushing amorphous photoconductor. A very new type of image sensor (target) for a camera tube. HARP target tubes are about 10 times more sensitive to light than conventional tube types and have been demonstrated to offer hope of overcoming the sensitivity drawbacks of HDTV cameras.

HBI See Horizontal Blanking Interval.

HBO Home Box Office. Time Inc.'s pay-cable and entertainment production company, a co-proposer with ATC of C-HDTV and supporter of ACTV.

HD High definition. A frequently used abbreviation for HDEP and sometimes HDTV. The term High Definition, applied to television, is almost as old as television itself. In its earliest stage, NTSC was considered high definition (previous television systems offered from 20 to 405 scanning lines per frame).

HDEP High Definition Electronic Production. A term bearing little or no implications for transmission and display systems. The SMPTE and the ATSC have approved one standard for HDEP, sometimes referred to as SMPTE 240M. This standard has 1,125 scanning lines per frame, 60 fields per second, 2:1 interlace, an aspect ratio of 16:9, extended colorimetry, and a 30 MHz base bandwidth for each of its three color components. It is based on work at NHK, but includes considerable American modifications. Clearly, the combined 90 MHz base bandwidth of this HDEP standard cannot be practically broadcast (not counting sound or modulation characteristics, it takes up as much bandwidth as 15 current broadcast channels). That is why there are so many ATV transmission schemes.

HD-MAC High definition MAC. A variety of systems, all European except for HDMAC-60.

HDMAC-60 The baseband and satellite transmission form of HDS-NA. See also MAC.

HDNTSC The terrestrial transmission form of HDS-NA, comprised of a receiver-compatible, channel-compatible signal and an augmentation channel, which may be half-sized and low-power. The augmentation channel carries increased resolution, improved sound, widescreen panels, and pan and scan information to let an ATV set know where to apply the panels.

HD-NTSC The Del Rey Group's ATV scheme, comprised primarily of a quincunx scanning scheme referred to as Tri-Scan, which would sub-sample each NTSC pixel three times, in a triangular fashion, for increased vertical and horizontal static resolution, at an effective 10 frame-per-second rate. Blanking adjustment is used for aspect ratio accommodation.

HD-PRO A universal, worldwide HDEP proposal from the Del Rey Group, said to accommodate all ATV systems. Details are not available pending patent protection.

HDS-NA High definition system for North America. The Philips Laboratories (Briarcliff, NY) ATV scheme, comprised of two separate systems, HDMAC-60, a single, satellite-deliverable channel designed to get the signal to broadcast stations and CATV head-ends, and HDNTSC, a two-channel (receiver-compatible plus augmentation) system to deliver it to home TVs.

HDTV High definition television. An ATV term sometimes confused with HDEP. HDTV is usually used to describe advanced production and delivery mechanisms that will get ATV to the home. As HDEP cannot practically be broadcast, all broadcast HDTV schemes must make compromises in quality. The line between broadcast HDTV and EDTV, therefore, is difficult to define. See Minimum Performance.

HDTV 1125/60 Group An organization of manufacturers supporting the SMPTE HDEP standard.

HDVS High Definition Video System. A Sony trade name for its HDEP equipment and ancillary products, such as HD videodisc players.

Head-End The part of a CATV system from which signals emanate.

High Definition Films British organization that began using the term High Definition for its electronic cinematography system before even color TV was broadcast in the U.S.

High Definition Television See HDTV.

High Frequency Subcarrier An information channel added to a television signal where the finest brightness detail is normally transmitted. As the human visual system is least sensitive to the finest detail, it is unlikely to be bothered by interference from such a subcarrier. This technique was first applied to the NTSC color subcarrier; most recently it has been proposed in Toshiba's ATV system.

High Line Rate More than 525 scanning lines per frame.

High Resolution Sciences Proponent of the CCF ATV scheme. HRS plans to offer other ATV schemes, including one using synchronized electron beam spatial modulation (turning each scanning line into a series of hills and valleys) in both camera and receiver to achieve increased vertical resolution.

Hitachi Proponent of the FUCE ATV scheme and enhanced versions of FUCE.

Hi-Vision Japanese term for HDTV.

HLO-PAL Half-line offset PAL. An early NHK proposal for an ATV transmission scheme.

Hole A volume in the three-dimensional NTSC spectrum into which an auxiliary sub-channel can be placed with minimal impairment. Holes are found where horizontal, vertical, and temporal detail are simultaneously high. The most famous hole is the Fukinuki hole, but the most common hole is the one carrying the NTSC color subcarrier.

Mark Schubin's

I

Horizontal Blanking Interval That portion of the scanning line not carrying a picture. In NTSC, the HBI carries a synchronizing pulse and a color reference signal. Some scrambling and other systems add sound and/or data signals to the HBI. Some ATV schemes fill it with widescreen panel or detail enhancement signals. See also Blanking and Blanking Stuffing.

Horizontal Resolution Detail across the screen, usually specified as the maximum number of alternating white and black vertical lines (lines of resolution) that can be individually perceived across the width of a picture, divided by the aspect ratio. This number is usually expressed as TV lines per picture height. The reason for dividing by the aspect ratio and expressing the result per picture height is to be able to easily compare horizontal and vertical resolution (see reference 22). Horizontal chroma resolution is measured between complementary colors (rather than black and white) but can vary in some systems (such as NTSC), depending on the colors chosen. Horizontal resolution in luminance and/or chrominance can vary in some systems between stationary (static resolution) and moving (dynamic resolution) pictures. It is usually directly related to bandwidth.

HQTV High quality TV. Another term for HDTV.

HRS High Resolution Sciences.

HVS Human visual system (eyes and brain).

HVT Horizontal, vertical, and temporal. The three axes of the spatio-temporal spectrum.

I Improved or increased; also the in-phase compenent of the NTSC color subcarrier, authorized to have more than twice as much horizontal resolution as the Q, or quadrature component. Few TV sets have ever taken advantage of this increased chroma resolution, though there is renewed interest.

IBA Britain's Independent Broadcasting Authority, home of a great deal of ATV research.

IBM Member of the AEA ATV Task Force; also one of the first organizations to suggest sub-sampling as a technique for compatibly increasing detail.

ICCE International Conference on Consumer Electronics, sponsored by the Consumer Electronics Society of the IEEE and held annually in the Chicago area immediately following CES. ATV has become an increasingly important topic at ICCE (see reference 30).

ICPM Incidental carrier phase modulation. A transmission defect most noticeable as a cause of sync buzz.

IDTV Improved definition television. A term now widely accepted to mean improvements restricted to television sets, many of which are listed in Table IV.

IEEE Institute of Electrical and Electronics Engineers. An organization that has created some television standards, has published a great deal of information about ATV, and is a charter member of ATSC.

IF Intermediate frequency. The first stage in converting a broadcast television signal into baseband video and audio.

IIT Illinois Institute of Technology. Home of much of the research into the SLSC ATV scheme.

Ikegami Broadcast equipment manufacturer involved in a number of ATV schemes, including production of HDEP equipment to the SMPTE standard and schemes involving the use of a line doubler either before or after transmission.

Image Enhancement Techniques for increasing apparent sharpness without increasing actual resolution. This usually takes the form of increasing the brightness change at edges. Since image enhancement has advanced continuously for nearly 50 years, ordinary NTSC pictures sometimes look better than the NTSC pictures derived from an HDEP source, particularly when these derived pictures are designed to be augmented by other signals in an ATV receiver. It is very difficult to enhance pictures for NTSC receivers and then unenhance them for receivers with augmentation.

Image Transform First U.S. organization to modify television scanning for electronic cinematography, utilizing 655 scanning lines per frame at 24 frames per second. Also created Imagevision.

Imagevision An early HDEP scheme utilizing 655 scanning lines per frame and 24 frames per second, with wide bandwidth video recording and a color subcarrier shifted to a higher frequency. Created and used by Image Transform for electronic cinematography.

Impairments Defects introduced by an ATV scheme. See Table V.

Impulsive Noise High level, short duration unwanted signals that tend to cause a sparkling effect in the picture and/or a percussive effect in the sound. Impulsive noise is often caused by motorized appliances and tools.

INRS French acronym for the National Scientific Research Institute of the University of Quebec. INRS-Telecommunications shares facilities with Bell Northern Research, sort of Canada's Bell Labs, and has simulated both advanced encoders and ATV schemes on its computer simulation system.

Interference Defect of signal reproduction caused by a combination of two or more signals that must be separated, whether all are desired or not.

Interlace Technique for increasing picture repetition rate without increasing base bandwidth by dividing a frame into sequential fields. When first introduced, it also had the characteristic of making the scanning structure much less visible (see reference 21). NTSC uses 2:1 interlace (two fields per frame).

Interlace Artifacts Picture defects caused by interlace. These include twitter, line crawl, loss of resolution, and motion artifacts. In addition to causing artifacts, interlaced scanning reduces the self-sharpening effect of visible scanning lines and makes vertical image enhancement more difficult to perform.

Interlace Coefficient A number describing the loss of vertical resolution due to interlace, in addition to any other loss. It is sometimes confused with the Kell factor.

Interlaced Carrier A television subcarrier at a frequency that is an odd multiple of one half the line rate (for example, the NTSC color subcarrier). Such subcarriers fall onto a line in the spatio-temporal spectrum that is simultaneously high in vertical detail and in temporal detail, and is therefore not likely to be objectionably visible under normal viewing conditions.

Table III: WHAT'S WRONG WITH NTSC

A. Monochrome and Color Defects

1. Due to Sampling
   - Temporal Alias
   - Vertical Alias
   - Vertical Resolution Loss (Kell Factor)
2. Due to aperture
   - Visible Scanning Lines
   - Soft Vertical Edges
3. Due to Interlace
   - Twitter
   - Line Crawl
   - Vertical Resolution Loss (Interlace Coefficient)
   - Motion Artifacts, Vertical and Horizontal
4. Due to Transmission
   - Ghosts
   - ICPM
   - Group Delay
   - Impulsive Noise
   - Periodic Noise
   - Random Noise
   - Interference
   - Filter Artifacts
5. Due to Changing Equipment
   - Non-Linear System Gamma

B. Color Defects

1. Visible in Monochrome
   - Cross Luminance
     Visible Subcarrier
     Chroma Crawl
   - Gamma Problems
   - Detail Loss Due to Filters
   - Ringing Due to Filters
2. Visible in Color
   - Cross Color
   - Detail Loss Due to Filters
   - Ringing Due to Filters
   - Detail Loss Due to Triad Size

C. Characteristic of the System (Not Necessarily Defects)

- 4:3 Aspect Ratio
- 330 x 330 Resolution
- NTSC Colorimetry
- 15 kHz Sound

Interlaced Scanning Television scanning employing interlace.

Interline Flicker See Twitter.

International Thomson Name used by France's Thomson group for some recently acquired holdings outside of France. International Thomson is a strong proponent of progressive-scan ATV and has proposed two such schemes for NTSC countries, both of which would offer a 16:9 aspect ratio and 60 frames per second. One would have 900 scanning lines (864 active), matching the number of scanning lines in International Thomson's proposal for non-NTSC countries. The other would have 750 scanning lines (728 active), matching the digitization rates in the non-NTSC proposal.

Inverse Nyquist Filter A filter that is a complement of the filter used to reduce interference in the IF section of a television set.

INTSC Improved NTSC. A term rarely used to describe ATV schemes incorporating any combination of the techniques of Table IV (see reference 25).

IQTV Improved quality television. A rarely used term for IDTV and INTSC.

Iredale, Richard Creator of the HD-NTSC ATV scheme and the HD-PRO HDEP scheme.

ISDB Integrated Services Digital Broadcasting. An NHK-suggested broadcast equivalent to ISDN.

ISDN Integrated Services Digital Network. A telecommunications concept and series of standards whereby one, universal, digital transmission network can carry computer data, voice, still and moving pictures (at any quality level), and high fidelity sound. ISDN is in the process of being slowly implemented by telephone companies worldwide.

J

Japan Broadcasting Corporation See NHK.

JCIC Joint Committee for Inter-Society Coordination. A group comprised of the EIA, the IEEE, the NAB, the NCTA, and the SMPTE. The JCIC created the ATSC in 1982 to handle all of the new advances in TV, including HDTV. The ATSC has since grown to 52 member and observer organizations.

Jitter A rapid, small shift in image position characteristic of film projection. Projection jitter can reduce the apparent resolution of film.

JND Just noticeable difference. A measure of the minimum perceptible change in quality. A one JND change is accurately detected 75 percent of the time; a three JND change is accurately detected 99 percent of the time. There is a large number of JNDs of difference between NTSC as it is now received in U.S. homes and HDEP. This difference decreases in ATV systems in pretty much the order of the hierarchy of Table VI. Some feel that a large number of JNDs will be necessary for consumers to purchase new TV sets (see reference 15).

Judder Jerkiness of motion associated with presentation rates below the fusion frequency.

K

Kell Factor A number describing the loss of vertical resolution from that expected for the number of active scanning lines, named for Ray Kell, a researcher at RCA Laboratories. Many researchers have come up with different Kell factors for progressively scanned television systems. These differences are based on such factors as aperture shape, image content, and measurement technique. A generally accepted figure for the Kell factor is around 0.68, which, multiplied by the 484 active NTSC scanning lines, yields a vertical resolution of 330 lines, matched by NTSC's 330 lines of horizontal resolution per picture height (see Square Pixels). It is important to note that most studies of the Kell factor measure resolution reduction in a progressive scanning system. Interlaced scanning systems suffer from both a Kell factor and an interlace coefficient.

kHz Kilohertz, thousands of cycles per second.

L

Large-Area Flicker Flicker of the overall image or large parts of it. See also Flicker Frequency and Twitter.

Laser Beam Recording A technique for recording video on film.

Lechner Distance Named for Bernard Lechner, researcher at RCA Laboratories. The Lechner distance is nine feet, the typical distance Americans sit from television sets, regardless of screen size. The Jackson distance, three meters, named for Richard Jackson, a researcher at Philips in Britain, is similar. There is reason to believe that the Lechner and Jackson distances are why HDTV research was undertaken sooner in Japan (where viewing distances are shorter) than elsewhere (see reference 28). See also Viewing Distance.

Letterbox Term generally used for the form of aspect ratio accomodation involving increasing vertical blanking. See Blanking Adjustment.

Line Crawl Tendency of the eyes to follow the sequentially flashing scanning lines of interlaced scanning up or down the screen in the same way that the eyes follow the sequentially flashing light bulbs on a movie theater marquee. Line crawl tends to reduce vertical resolution.

Line Doubling Any number of schemes to convert interlaced scanning to progressive scanning at the display, the simplest of which simply doubles each scanning line. More elaborate schemes use line interpolation and motion compensation or median filtering.

Line Interpolation An advanced mechanism used in some line doublers that calculates the value of scanning lines to be inserted between existing ones.

Table IV: TECHNIQUES TO IMPROVE NTSC COMPATIBLY

A. Monochrome and Color

1. Sampling, Aperture, and Interlace Problems
   - Progressive Display
   - High Line Rate Display
   - Progressive Camera and Prefiltering
   - High Line Rate Camera and Prefiltering
   - Image Enhancement at the Camera
   - Image Enhancement at the Receiver
2. Transmission Problems
   - Ghost Elimination
   - Noise Reduction
   - Improved Filter Design and Adjustment
3. Changing Equipment Problems
   - Gamma Correction
   - Adaptive Emphasis
   - Rigid Adherence to Standards

B. Color Problems

- Improved Decoder Filtering
- Prefiltering
- Full Detail Decoders
- Luminance Detail Derived from Pre-Encoded Chroma

Line Pairing A reduction in vertical resolution caused when a display (or camera) does not correctly space fields, resulting in an overlap of odd and even numbered scanning lines. See also Random Interlace.

Line Pairs A measure of resolution often used in film and print media. In television, lines are used instead, creating confusion when comparing film and video.

Line Rate The rate at which scanning lines appear per second (the number of scanning lines per frame times the frame rate); sometimes used (non-quantitatively) as an indication of the number of scanning lines per frame (e.g., a high line rate camera).

Lines Scanning lines or lines of resolution. The latter are hypothetical lines alternating between white and black (or, in the case of chroma resolution, between complementary colors). The combined maximum number of black and white lines that might be perceived in a particular direction is the number of lines of resolution. Vertical resolution is measured with horizontal lines; horizontal resolution is measured with vertical lines; diagonal resolution is measured with diagonal lines (no current television system or proposal favors one diagonal direction over the other, so the direction of the diagonal lines does not really matter). See also PPH.

Line Structure Visibility The ability to see scanning lines. Seeing them makes it harder to see the image (like looking out a window through venetian blinds or not being able to see the forest for the trees). Some ATV schemes propose blurring the boundary between scanning lines for this reason (see reference 28).

Luminance The brightness detail signal. The human visual system is more sensitive to luminance detail than to chrominance detail.

M

M The CCIR designation for 525 scanning-line/30 frame-per-second television. U.S. color television is internationally designated NTSC-M. The M standard is the world's second oldest (the oldest was a 405-line/25 frame British standard, no longer broadcast).

MAC Multiplexed analog components. A large family of television signal formats sharing the following two characteristics: color remains in a component rather than composite form, and luminance and chrominance components are time compressed so that active line time remains constant, with chrominance following luminance. Most of the MACs also include digital audio/data channels. Since they are non-composite, MACs do not suffer from any cross-luminance or cross-color effects. Since they are time compressed, they tend to have a greater base bandwidth than composite signals. See also ACLE, A-MAC, B-MAC, C-MAC, D-MAC, D2-MAC, HD-MAC, HD-MAC60, MAC-60, MUSE, and S-MAC.

MAC-60 An early version of the HDMAC-60 signal.

Main Channel The basic transmission channel of an ATV channel utilizing an augmentation channel.

Matched Resolution A term sometimes used to describe matching the resolution of a television system to the picture size and viewing distance (visual acuity); more often a term used to describe the matching of horizontal and vertical (and sometimes diagonal) resolutions. There is some evidence that the lowest resolution in a system (e.g., vertical resolution) can restrict the perception of higher resolutions in other directions. See also Square Pixels.

Mathias, Harry Cinematographer, designer, teacher, consultant, and author who came up with the six priorities of electronic cinematography listed in Table VII.

Matsushita Parent of Panasonic and Quasar, majority owner of JVC, first company to demonstrate an HD camera and display in the U.S., has continued demonstrations (most recently at this summer's CES), and developed the QUME and QAM ATV schemes, which popularized the idea of quadrature modulation of the picture carrier.

Mbps Megabits per second, a data transmission rate in millions of binary digits per second.

Median Filter An averaging technique used by PCEC in its IDTV line interpolation scheme to take an average of lines in the current and previous fields to optimize resolution and avoid motion artifacts without using motion compensation.

MHz Megahertz; millions of cycles per second. A normal U.S. television transmission channel is 6 MHz. The base bandwidth of the video signal in that channel is 4.2 MHz. The SMPTE HDEP system calls for 30 MHz each for red, green, and blue channels.

Minimum Performance The line between EDTV and HDTV. Naturally, each ATV proponent defines minimum performance so as to favor its system to the detriment of others.

MIT Massachussets Institute of Technology. Home of the Media Lab and its Advanced Television Research Program (ATRP), its Audience Research Facility, its Movies of the Future program, and other advanced imaging and entertainment technology research. In addition to conducting and publishing a great deal of ATV research, MIT has come up with two ATV proposals of its own, one called the Bandwidth Efficient Proposal and one the Receiver Compatible Proposal.

Modulation The process (or result) of changing information (audio, video, data, etc.) into information-carrying signals suitable for transmission and/or recording. In NTSC-M television transmission, video is modulated onto a picture carrier using AM-VSB, and audio is modulated onto a sound carrier using FM.

Moire A wavy pattern, usually caused by interference. When that interference is cross-color, the pattern is colored, even if the picture is not.

Monochrome Literally single color, usually used to indicate black and white. There have been monochrome high line rate cameras and displays for many years. The EIA has standardized rates of up to 1,225 scanning lines per frame. NHK developed a monochrome HDTV system with 2,125 scanning lines per frame. Even higher numbers of scanning lines are used in conjunction with lower frame rates in cathode ray tube scanners used in printing and in film. These extremely high rates are possible because monochrome picture tubes have no triads.

Motion Adaptive An ATV scheme that senses motion and changes the way it functions to avoid or reduce motion artifacts.

Motion Artifacts Picture defects that appear only when there is motion in the scene. Interlaced scanning has motion artifacts in both the vertical and horizontal directions. There is a halving of vertical resolution at certain rates of vertical motion (when the detail in one field appears in the position of the next field one sixtieth of a second later), and horizontally moving vertical edges become segmented (reduced in resolution) by the sequential fields. This is most apparent when a frame of a motion sequence is frozen and the two fields flash different information. All sub-sampling ATV schemes have some form of motion artifact, from twinkling detail to dramatic differences between static and dynamic resolutions. Line doubling schemes and advanced encoders and decoders can have motion artifacts, depending on how they are implemented. Techniques for avoiding motion artifacts include median filtering and motion adaptation or compensation.

Motion Compensation Correction for motion to avoid or reduce motion artifacts. See also Motion Adaptive.

Motion Resolution See Dynamic Resolution.

N

Motion Surprise A major shift in the quality of a television picture in the presence of motion that is so jarring to the viewer that the system might actually appear better if it had continuously lower quality, rather than jumping from a high-quality static image to a lower quality dynamic one.

Moving Dots See Chroma Crawl.

Multipath Distortion A form of interference caused by signal reflections. Signals that are reflected more take a longer path to reach the receiver than those that are reflected less. The receiver will synchronize to the strongest signal, with the weaker signals travelling via different paths causing ghostly images superimposed on the main image. Since many ATV schemes offer increased horizontal resolution, ghosts can have a more deleterious effect on them than on ordinary NTSC signals. There have been many demonstrations of ghost cancelling/eliminating systems and robust transmission systems over the years (see reference 3). It is likely that these will have to be used for HDTV.

Multiplex To combine multiple signals, usually in such a way that they can be separated. There are three major multiplexing techniques. Frequency division multiplex (FDM) assigns each signal a different frequency. This is how radio and television stations in the same metropolitan area can all transmit through the same air space and be individually tuned in. Time division multiplex (TDM) assigns different signals different time slots. Different programs can be broadcast over the same channel using this technique. More technically, the MACs use TDM for luminance and chrominance. Space or path division multiplex allows different television stations in different cities to use the same channel at the same time or different people to talk on different telephones in the same building at the same time.

MUSE Multiple sub-Nyquist sampling encoding. A term originally used for a transmission scheme developed by NHK specifically for DBS transmission of HDTV. MUSE has since been extended to a family of ATV transmission schemes. MUSE, as it was originally developed, is a form of MAC. Recent versions of MUSE (MUSE-6 and MUSE-9) are said to be receiver-compatible and, as such, cannot employ MAC techniques. The sub-Nyquist part of the name indicates that MUSE is a sub-sampling system and, as such, is subject to motion artifacts. While it is one of the oldest ATV transmission schemes still considered viable, MUSE is only four years old.

MUSE-E MUSE optimized for emission (i.e., broadcasting) rather than transmission (i.e., satellite distribution). It is a non-receiver-compatible, non-channel-compatible scheme occupying 8.1 MHz of base bandwidth and requiring four fields to build up a full-resolution picture. Thus, it requires motion compensation (and retains some motion artifacts). It offers four channels of high-quality digital audio. It has been tested in the Washington, DC area.

MUSE-T MUSE optimized for transmission (via satellite) rather than emission (via terrestrial broadcasting). It occupies twice the bandwidth of MUSE-E (16.2 MHz), but is otherwise quite similar.

MUSE-II See MUSE-E.

MUSE-6 A family of three versions of an ATV transmission scheme said to be both receiver-compatible and channel-compatible. Since the original MUSE schemes are neither, there is little similarity between them, other than the use of sub-sampling. The differences between the three versions relate to how the wide aspect ratio is handled and what techniques are used for augmentation in an ATV set. Two versions of MUSE-6 use the letterbox technique for aspect ratio accommodation and both of these use blanking stuffing in the expanded VBI area for vertical resolution enhancement. The differences between the two versions relate to the duration of the sub-sampling sequence (one frame or two). The third uses the truncation technique for aspect ratio accommodation, sending the side panels stuffed into the existing VBI and HBI. Additional horizontal detail is transmitted via two-frame sub-sampling.

MUSE-9 A family of three versions of an ATV transmission scheme said to be receiver-compatible and utilizing a 3 MHz augmentation channel. The three versions are very similar to the three versions of MUSE-6, except that the version using the truncation method sends the wide-screen panels on the augmentation channel rather than stuffing them into the HBI and the VBI. There are two classes of the three versions of MUSE-9, one with a contiguous augmentation channel and one without. The one without is said to be somewhat inferior in quality to the one with.

NAB National Association of Broadcasters; also their annual convention, which is the major U.S. showcase for HDEP equipment. NAB is also a participant in ATV testing and standardization work, and a charter member of ATSC. Though not a proponent of any particular ATV system, NAB lobbies for the interests of broadcasting as a delivery mechanism and has published some of the least biased information on the subject.

NAP North American Philips, whose Philips Laboratories developed the HDS-NA ATV scheme and was among the first to suggest advanced pre-combing. See also PCEC.

Narrowband Relatively restricted in bandwidth.

Narrow MUSE An NHK-proposed ATV scheme very similar to MUSE (and potentially able to use the same decoder) but fitting within a single, 6 MHz transmission channel. Unlike MUSE-6 and MUSE-9, Narrow MUSE is not receiver-compatible.

NBC Television network that was an original proponent of the ACTV ATV schemes. NBC was also the first network to announce its intention to shift from NTSC entirely to CAV recording equipment.

NCTA National Cable Television Association; also its annual convention. NCTA is performing similar roles to NAB in ATV research and lobbying, with an emphasis on CATV, rather than broadcasting, of course, and is a charter member of ATSC.

NHK Nippon Hoso Kyokai. The Japan Broadcasting Corporation, principal researchers of HDTV through the 1970s, developers of the 1125 scanning-line system for HDEP and of all the MUSE systems for transmission.

New York Institute of Technology Private engineering school headquartered in Old Westbury, NY, noted for its advanced computer graphics. Its Science and Technology Research Center, in Dania FL, has been researching ATV for years. NYIT is a proponent of the VISTA ATV scheme.

Nippon Television see NTV.

NTSC National Television System Committee. The name of two standardization groups, the first of which established the 525 scanning-line-per-frame/30 frame-per-second standard and the second of which established the color television system currently used in the United States; also the common name of the NTSC-established color system. NTSC is used throughout North America and Central America, except for the French islands of St. Pierre and Miquelon. It is also used in much of the Caribbean and in parts of South America, Asia, and the Pacific. It is also broadcast at U.S. military installations throughout the world and at some oil facilities in the Middle East. Barbados was the only country in the world to transmit NTSC color on a non-525-line system; they have since switched to 525 lines. Brazil remains the only 525-line country to transmit color TV that is not NTSC; their system is called PAL-M. M is the CCIR designation for 525-line/30 frame television. See also M.

NTSC Artifacts Defects associated with NTSC, listed in Table III.

NTSC-M The U.S. standard of color television transmission. See also NTSC and M.

NTSC MUSE Term sometimes used for MUSE-6 and MUSE-9.

NTSC Standard Documentation of the characteristics of NTSC. NTSC is defined primarily in FCC Part 73 technical specifications. Many of its characteristics are defined in EIA-170A. NTSC is also defined by the CCIR. NTSC is a living standard; as problems with it are discovered, they are corrected. For example, a former EIA standard, RS-170, omitted any phase relationship between luminance and chrominance timing, resulting in blanking problems. EIA-170A defines that relationship (called SC/H for subcarrier to horizontal phase relationship). See also True NTSC.

NTV Nippon Television Network. A Japanese broadcaster that is a proponent of ATV schemes similar to Faroudja's SuperNTSC. NTV's first generation EDTV system would use high line-rate and/or progressive scan cameras with prefiltering, adaptive emphasis, gamma correction, ghost cancellation, a progressive scan display, and advanced decoding at the receiver. The second generation would add more resolution, a widescreen aspect ratio, and better sound. The first generation is scheduled to be broadcast beginning in 1988.

NYIT see New York Institute of Technology.

Nyquist Nyquist Filter, Nyquist Limit, Nyquist Rule, and Harry Nyquist, for whom they are named. The Nyquist rule states that in order to be able to reconstruct a sampled signal without aliases, the sampling must occur at a rate of more than twice the highest desired frequency. The Nyquist limit is the highest frequency that can be captured without alias for any given sampling rate, essentially half the sampling rate. The Nyquist filter is commonly used in the IF stage of a television receiver to separate the desired television channel from potential interference. The Nyquist rule is usually observed in digital systems. For example, CDs have a sampling frequency of 44.1 kHz to allow signals up to 20 kHz to be recorded. It is, however, frequently violated in the vertical and temporal sampling of television, resulting in aliases. See also Alias.

O

Odd Number The number of scanning lines per frame necessary in an interlaced scanning system. One line is split between fields to ensure proper spacing between scanning lines from different fields. A progressively scanned system may use an even number of scanning lines.

Open Architecture A concept for television receivers that acknowledges an absence of ATV transmission/distribution standards and allows a receiver to deal with a multiplicity of standards and delivery mechanisms.

Optical Fiber A glass strand designed to carry light in a fashion similar to the manner in which wires carry electrical signals. Since light is electromagnetic radiation of tremendously high frequency, optical fibers can carry much more information than can wires, though multiple paths through the fiber place an upper limit on transmission over long distances due to a characteristic called pulse dispersion. Many feel that the wide bandwidth of an optical fiber eliminates the transmission problems associated with the high base bandwidth of HDEP schemes. CATV and telephone companies propose connecting optical fibers directly to homes (see "Switched Optics: The Demise of the Throne Phone?", VIDEOGRAPHY, September 1977 and "The World of CATV Engineering and the CATV Engineering of the World," VIDEOGRAPHY, April 1978).

Orientation A direction of presentation affecting resolution requirements. Horizontal lines become vertical lines when their orientation is rotated by 90 degrees; a pattern of dots appearing to be in horizontal and vertical rows may not appear to be diagonally aligned when its orientation is rotated 45 degrees due to characteristics of the human visual system.

Orthogonal Sampling Picture sampling arranged in horizontal rows and vertical columns, as opposed to, say quincunx sampling.

Osborne, Joseph An ATV proponent issued a patent for a data compression transmission scheme for HD signals. The Osborne compression system is said to allow channel-compatible but not receiver-compatible HDTV.

Overscanning Displaying less than the complete area of an image to a viewer (i.e., scanning beyond the visible area). All TV sets are overscanned at least slightly, so that viewers do not see blanking (the size of which can vary). The restricted areas of the SMPTE Safe Action Area and the SMPTE Safe Title Area take this overscanning into account. Some ATV schemes propose transmitting information in the overscanned area where it would neither be seen by viewers nor affect synchronizing signals. Newer TV sets have less overscanning than their predecessors.

Table V:
TECHNIQUES FOR HIDING MORE DETAIL IN NTSC AND POTENTIAL IMPAIRMENTS IN NON-ATV RECEIVERS

Technique:

1. Horizontal Blanking Stuffing
2. Vertical Blanking Stuffing
3. Subcarriers
4. Picture Carrier Quadrature Modulation
5. Sub-Sampling

Potential Impairments:

1. Visibility; Sync and Burst Interference
2. Visibility if in Normal Picture Area
3. Cross-Luminance Effects
4. Visibility in Envelope Detector Sets
5. Visible Fine Detail Twinkle

P

PAF Phase alternation by field. An early proposal for HDTV transmission; also a line on the spatio-temporal spectrum where interlaced carriers undergoing phase alternation by field fall and the holes that may be made for them (the Fukinuki hole is centered on the PAF line).

PAL Phase alternation by line. A common composite color transmission system (like NTSC) used in many countries of the world where there are 625 scanning lines per frame and 25 frames per second. Brazil is the only country in the world transmitting PAL on a 525/30 system.

Pan and Scan A process for aspect ratio accommodation wherein an area with the display's aspect ratio is moved across the source's area to follow action across the screen. Pan and scan may be implemented either by introducing panning that was not in the original scene or by repositioning the area between frames, thus introducing edits that were not in the original scene.

Panels The picture area left over when a narrow aspect ratio is superimposed on a wider one. Also sometimes called side panels or widescreen panels. Some ATV schemes transmit the panels separately from the center of the picture, as a subchannel, in an augmentation channel, and/or stuffed into blanking.

PCEC Philips Consumer Electronics Company. A U.S. branch of Philips selling IDTV receivers.

Pels Picture elements. The smallest dots that can be transmitted for any given bandwidth and scanning system.

Periodic Noise An interfering signal of a particular frequency, which causes a stationary or moving pattern to appear on a screen.

Philips Philips' Gloeilampenfabrieken, N.V. (Philips' Incandescent Lightbulb Factory, Inc.), a Dutch company with American branches whose products are sold in the U.S. under the brands Amperex, BTS, Magnavox, Norelco, Philco, Philips, and Sylvania. Philips Laboratories of Briarcliff, NY, is a proponent of the HDS-NA ATV schemes (HDMAC-60 and HDNTSC). PCEC sells IDTV receivers. Philips Laboratories of Redhill, England and Philips Laboratories of Eindhoven, Holland have both proposed HDEP and ATV schemes for Europe and the U.S.

Philosophy Concept of how ATV should be implemented. See Table VI.

Phosphor Material that glows when struck by an electron beam in a CRT, the source of the light emitted by TV screens. Phosphor composition determines the maximum range of colors that can be displayed.

Phosphor Aging Reduction in the amount of light emitted by phosphors due to deterioration with use.

Picture Carrier The transmitted signal onto which video information is modulated in television broadcasting.

Picture Heights A measurement of viewer distance from a screen in terms of the height of a picture. For example, a viewer sitting five feet from a one-foot-high picture would be said to be viewing from a distance of five picture heights (see reference 28).

Pixel Count A disputed measure of the spatial resolution of a television system in terms of perceiveable pixels.

Pixels Picture elements. See Pels.

Table VI: ATV PHILOSOPHIES

1. IDTV—Receiver Improvements Only
2. Advanced Encoding—Camera Scanning Unchanged
3. Prefiltered High Line Rate/Progressive Cameras—Channel Unchanged
4. Channel Stuffing (Table V) for Resolution and/or Widescreen
5. Augmentation Channel for Resolution and/or Widescreen
6. Incompatible 6 MHz Channel
7. Incompatible Channel Larger than 6 MHz

PPH Per picture height. The standard method of specifying horizontal resolution so that it can be compared directly to vertical resolution. It is obtained by dividing the total horizontal resolution by the aspect ratio, thus obtaining a figure in TV lines per picture height, the number of lines that can be perceived in a width the same as the height of the picture.

PPW Per picture width. A method of specifying horizontal resolution sometimes used when a large number is desired. See also PPH.

Pre-Combing A form of pre-filtering used to prevent interference when chrominance and luminance are combined in an encoder. Some forms of pre-combing can restrict the performance of a receiver equipped with some forms of advanced decoders. Pre-combing can be considered a cleaning of a hole and the subcarrier that will be inserted into it.

Pre-Filtering Filtering performed at the transmission or production end of a television system. There are two forms associated with ATV schemes. One is pre-filtering of chrominance and luminance (or any subcarrier and its hole) to permit separation at the receiver without interference (such as cross-color and cross-luminance). The other involves the use of a high line rate and/or progressively scanned camera for production, then filtering its output to a form that can be transmitted over the desired channel (e.g., 525 scanning lines with 2:1 interlace). This can eliminate or reduce many artifacts. See Tables III & IV.

Production Services A proponent of an ATV scheme.

Production Standard A set of rules to be followed to create programming compatible with equipment designed to the same rules. In NTSC, the production standard (EIA-170A) is essentially identical to the transmission standard (FCC Part 73). Both use 525 scanning lines at 29.97 frames per second. In ATV, however, the two may be dramatically different. The SMPTE HDEP standard (240M), for example, calls for three 30 MHz channels for a single HDEP signal. No ATV transmission proposal uses anywhere near that much. SMPTE 240M also calls for 1,125 scanning lines at 60.00 frames per second. Therefore, many assume that a transmission standard will demand the same number of scanning lines and frame rate. Yet, a number of ATV transmission schemes involving less than 1,125 scanning lines have been demonstrated utilizing 1,125 line HDEP equipment. Standards conversion from a production standard to a transmission standard may, in fact, be simpler than current standards conversion from NTSC's 525/30 to European 625/25. The only current worldwide production standard is 35mm film.

Progressive Scanning A television scanning system in which each scanning line follows its predecessor in a progressive fashion, rather than skipping intermediate lines to be filled in by the next field. In a progressive scanning system, the field rate and the frame rate are identical, and there are none of the interlace artifacts of Table III. Progressive scanning is also called sequential scanning.

Q

Q Quality (e.g., EQTV); also the quadrature component of the NTSC color subcarrier.

QAM Quadrature amplitude modulation; current name for Matsushita's QUME ATV scheme.

Quadrature Modulation A technique for modulating a carrier with two different signals simultaneously, without interference. The signals are spaced 90 degrees apart, creating, with their positive and negative components, the four quadrants that give the signal its name. The NTSC color subcarrier is supposed to be quadrature modulated with I and Q color difference signals; sometimes R-Y (red minus luminance) and B-Y (blue minus luminance) are used instead. The I and Q axes are rotated 33 degrees from the R-Y and B-Y axes. Matsushita recently proposed quadrature modulation of the picture carrier as a technique for providing a built-in augmentation channel for broadcast and CATV delivery schemes for ATV. Though there is some question about whether such modulation could impair performance in envelope detector television sets, the concept of quadrature modulation of the picture carrier has been embraced by others and is part of ACTV. Quadrature modulation is an AM process and, therefore, cannot be used with conventional satellite transmission or video recording schemes, which use FM. Another technique for modulating two signals on a single carrier is DSSB.

Quanticon A proponent of an ATV scheme.

Quincunx Sampling Sampling of an image checkerboard-style, as opposed to orthogonal sampling. Many sub-sampling schemes, such as HD-NTSC, use a form of quincunx sampling.

QUME Quadrature modulating extended definition television system, a Matsushita proposal for adding widescreen panels or increasing definition through quadrature modulation of the picture carrier. Now called QAM.

R

Random Interlace Obsolete form of inexpensive 525 scanning-line system with such poor interlace that line pairing was the norm rather than the exception.

Random Noise Also called thermal noise, a transmission or recording impairment that manifests itself as snow in a picture and hiss in sound. A number of techniques have been developed to reduce random noise in a picture through signal averaging.

Raster A set of scanning lines; also the type of image sampling using scanning lines (as in raster scanning).

RBOC Regional Bell Operating Company, an acronym sometimes applied to the Baby Bell holding companies and sometimes to individual Bell telephone companies. See also Baby Bell.

RCA Radio Corporation of America, now part of GE. RCA was once involved in every aspect of television, from camera to receiver, supplying production, transmission, consumer electronic, and CATV equipment, and operating a television network (NBC) and a satellite transmission carrier. RCA developed the first effective HDTV camera tube, proposed several HDEP schemes ranging from 750 to 2,625 scanning lines, and did extensive ATV research at RCA Laboratories (now SRI International's DSRC). RCA's broadcast equipment group no longer exists, Burle is selling its tubes, and its consumer electronics are now part of the Thomson group. GE has, thus far, retained the satellite transmission carrier (renaming it GE Americom) and the NBC television network, a proponent of the ACTV ATV schemes.

Reagan, Ronald First U.S. president to be recorded on HDEP, at the 1988 NAB convention.

Receiver-Compatible Term used for an ATV scheme that allows existing NTSC television sets to tune into the ATV signal and get pictures and sounds; also used to describe an MIT ATV scheme utilizing blanking adjustment for aspect ratio accommodation and utilizing various subchannels to carry additional information but requiring a very complex receiver to recover that information. It is said to offer 600 lines of vertical and 660 lines of horizontal static luminance resolution, with reduced static diagonal resolution and with dynamic resolution comparable to NTSC. The term Receiver Compatibility, as it is usually used, allows some degradation in pictures from the highest NTSC quality, in the same way that the receiver-compatible NTSC color system introduced cross-luminance to existing black-and-white TV sets.

Recommendation 601 A CCIR recommendation (standard) for digital component video, equally applicable to 525 and 625 scanning lines, also called 4:2:2 (see reference 29). Digital component video is about as close in quality as current 525 scanning line equipment can come to ATV.

Resolution Perceiveable detail. See also Chroma Resolution, Diagonal Resolution, Dynamic Resolution, Horizontal Resolution, Spatial Resolution, Static Resolution, and Temporal Resolution.

RF Radio frequency. A term used for modulated signals, as opposed to baseband. See also IF and Baseband.

RGB Red, green, and blue, the most basic color components.

RHC Regional holding company. See Baby Bell.

Ringing A common filter artifact, manifesting itself in television pictures as ghost-like images of sharp edges.

Robust Term for a transmission or recording scheme that can tolerate significant impairments (such as those noted in the transmission section of Table III), without catastrophic failure (severe degradation).

RS-170A Now called EIA-170A, the EIA standard for NTSC television production equipment.

Table VII:
HARRY MATHIAS' PRIORITIES FOR ELECTRONIC CINEMATOGRAPHY (In Order of Importance)

1. Practicality, Flexibility, and Ruggedness
2. Aspect Ratio
3. Sensitivity
4. Gamma or Transfer Characteristic
5. Resolution
6. Standards Acceptance (or Standards Conversion)

From "Image Quality from a Non-Engineering Viewpoint," SMPTE Television Engineering Conference, 1984

S

SA Scientific-Atlanta

Sampling The process of dealing with something continuous in discrete sections. Sampling is probably best known as the first step in the process of digitization, wherein an analog (continuous) signal is divided into discrete moments in time. Yet, even analog television signals have already been sampled twice: once temporally (time being sampled in discrete frames) and once vertically (the vertical direction being divided into discrete scanning lines). If these initial sampling processes are not appropriately filtered (and they rarely are in television), they can lead to aliases. See also Alias, Digitization, and Nyquist.

Sarnoff, David As general manager, president, and chair of the board of RCA, he strongly shaped the future of television; also the David Sarnoff Research Center named for him, currently part of SRI International, formerly RCA Laboratories, home of ACTV research and development.

Saturated Color A color as far from white, black, or grey as it can be (e.g., vermillion rather than pink).

Scanning Circuitry Camera or display subsystems designed for moving an electron beam around to form a raster.

Scanning Lines Horizontal or near-horizontal lines sampling a television image in the vertical direction. In tube-type cameras and displays equipped with CRTs, the scanning lines are caused by electron beam traces. See also Table VIII.

Scanning Structure A term sometimes used to describe a number of scanning lines per frame, interlace ratio, and frame rate; also sometimes used to describe what appears when scanning lines are visible.

Scrambling Usually used as a synonym for encryption, controlled disordering of a signal to prevent unauthorized reception; sometimes used to describe controlled disorganization of a signal to improve its robustness. The latter form is more often called shuffling.

Scientific-Atlanta CATV, satellite transmission, and production equipment firm that has been selling B-MAC equipment for years and is a proponent of the HDB-MAC ATV scheme.

Schreiber, William F. Head of ATRP, who is so outspoken that some of his many papers on the subject of ATV carry the disclaimer that they are not official ATRP pronouncements. In addition to evaluating many ATV schemes and describing how others might work, Schreiber has proposed his own ATRP scheme, sometimes referred to as the bandwidth efficient scheme. See also Bandwidth Efficient.

Seams Vertical lines in the picture where separately transmitted widescreen panels are joined to the center of the image. CBS proved that seams could be made invisible in its two-channel ATV transmission scheme.

Seam Elimination Techniques to make panel seams invisible.

Sensitivity The amount of signal a camera can emit from a particular sensor illumination at a particular SNR, sometimes expressed as a certain scene illumination (in lux or footcandles) at an assumed reflectance and signal strength, at a particular lens transmission aperture, at a particular SNR. The sensitivity of a camera can be truly increased by improving its image sensor, increasing its transmission aperture, or slowing its frame rate; it can be seemingly increased by allowing the SNR to be reduced. All other things being equal, at this time the sensitivity of an HDEP camera is less than the sensitivity of an NTSC camera. The sensitivity of first-generation HDTV 1,125 scanning-line cameras is two to three stops less sensitive than that of a 525-line camera (needing four to eight times as much light). HARP tubes and new CCD advances may offer a solution to this problem.

Sequential Scanning Progressive scanning, so named because scanning lines are transmitted in numerical sequence, rather than in odd- or even-numbered fields, as in interlaced scanning.

SFP Societe Francaise de Production et de Creation Audiovisuelles, drafter of the French proposals.

Sharpness Apparent image resolution. High sharpness may be the result of high resolution, or it might be an optical illusion caused by image enhancement or by visible edges in a display, such as the vertical stripes of an aperture grille CRT (e.g., Trinitron). Visible scanning lines can actually increase perceived sharpness. This may be one reason why, in some subjective ATV tests, some viewers have expressed a preference for NTSC pictures over ATV.

SHF Super high frequency. The band of frequencies ranging from 3 GHz to 30 GHz, currently including all communications satellite signals and most microwave transmissions. SHF has been suggested as a band to be used for terrestrial ATV transmission channels.

Shoot and Protect A concept of aspect ratio accommodation central to the selection of the 16:9 aspect ratio for the SMPTE HDEP standard. In a shoot and protect system, in production the action is confined to certain bounds (the shoot range) but a larger area (the protect range) is kept free of microphone booms, lights, and other distracting elements. Shoot and protect has been used for years in film, where the shoot aspect ratio is the 1.85:1 used in U.S. theatrical projection, and the protect aspect ratio is the 1.33:1 used in NTSC. The 16:9 aspect ratio was selected mathematically as the one requiring the least area to protect both 1.33:1 television and 2.35:1 widescreen film. In such a system, both the shoot and the protect aspect ratios would be 16:9. A rectangle of shoot width and protect height would be 1.33:1 (12:9); a rectangle of shoot height and protect width would be 2.35:1 (about 21:9). The concept of 3-perf film conflicts strongly with 1.85:1 shoot and protect.

Showscan A film process utilizing 70mm (65mm in the camera) film at 60 frames per second. It seems an ideal film production format (expense considerations aside) for transfer to ATV and has been demonstrated as such.

Sideband A signal that is a consequence of some forms of modulation. When modulation forms two sidebands, one can sometimes be filtered out to increase efficiency without sacrificing information.

Side Panels Additional sections of picture that, when added to a television image, change a 1.33:1 aspect ratio into a wider one. Many ATV schemes transmit these panels separately from the main picture.

Simulcast Simultaneous broadcast. Prior to the advent of multichannel television sound broadcasting, the only way to transmit a stereo television show to homes was by simultaneous broadcasting on TV and radio stations. Proponents of non-receiver compatible ATV schemes suggest the same technique to achieve compatibility with existing NTSC TV sets: The non-compatible ATV signal will be transmitted on one channel and a second channel will carry a standards-converted NTSC signal. It is sometimes suggested that such simulcast techniques of ATV transmission are more efficient than augmentation techniques since, when the penetration of ATV sets into households reaches some limit, the NTSC simulcast channel can be eliminated, conserving bandwidth. In Britain, an almost identical situation occurred when 625 scanning-line television replaced 405. For many years, all programming was simulcast in both line rates with 405 eventually eliminated.

Simulation A technique for trying an ATV scheme inside a computer without actually building specialized equipment. Some question the validity of ATV simulations.

Single Channel Channel-compatible, an ATV scheme fitting into 6 MHz of bandwidth.

SLSC Split-luminance, split-chrominance, a family of ATV schemes proposed by Bell Labs and IIT. SLSC is a receiver-compatible, non-channel compatible ATV scheme utilizing a high line rate camera and prefiltering with receiver line doubling to increase vertical resolution and additional bandwidth to increase horizontal resolution and help reduce NTSC artifacts. Aspect ratio is increased by blanking stuffing in the HBI. SLSC schemes have been proposed with at least two types of chroma encoding and three types of widescreen panel transmission.

S-MAC Studio MAC. A MAC designed for single-line transmission of CAV signals in a television facility or between facilities (see reference 29). See also MAC.

SMPTE Society of Motion Picture and Television Engineers. A television standards organization. SMPTE 240M is the first SMPTE HDEP standard, calling for 1,125 scanning lines, 2:1 interlace, a 16:9 aspect ratio, and 60 fields per second, among other characteristics. It is identical to the HDEP standard approved by ATSC. It need not be SMPTE's only HDEP standard, however. The Society has current standards for more than ten different videotape recording formats, with more pending. There are indications that members of SMPTE's WG-HDEP are interested in a progressively-scanned HDEP system, an evolution of the 1,125-line interlace standard.

SNR Signal-to-noise ratio. It may not be possible to directly compare SNRs for ATV and for NTSC as the eye's sensitivity to noise varies with the detail of the noise.

Sony First company to sell an HDEP recorder, making HDEP practical. Also the strongest HDEP proponent, spending a great deal to promote it and going so far as to display the products of some of its competitors, as long as they complied with the 1,125 scanning-line system.

Southwestern Bell A Baby Bell, and the first organization to transmit HDEP (as opposed to some bandwidth-reduced form of ATV) a long distance, via optical fiber.

Spatial Relating to the area of an image.

Spatial Resolution What is usually referred to as resolution, linearly measurable detail in an image, in the vertical, horizontal, or diagonal directions.

Spatio-Temporal Filtering Filtering in both space and time.

Spatio-Temporal Spectrum A three-dimensional representation of the energy distribution of a television signal. The three dimensions are horizontal, vertical, and time.

Spectrum Allocation Designation of certain bandwidths at certain frequencies for certain purposes. For example, channel 2 has been allocated 6 MHz of bandwidth from 54 MHz to 60 MHz for television broadcasting. All ATV transmission schemes require some form or another of spectrum allocation. See also Frequency Allocation Table.

Square Pixels Pixels generated in a television system having the same horizontal and vertical resolution. There is some evidence that a large mismatch between horizontal and vertical resolution prevents the higher resolution from being fully perceived by the human visual system. NTSC was created with square pixels with a resolution of approximately 330 by 330 lines.

Squeeze A change in aspect ratio. Anamorphic lenses sometimes squeeze a widescreen scene by a factor of two horizontally, so it will fit on a 1.33:1 aspect ratio frame. In projection, another anamorphic lens "expands" the squeeze (squeezes vertically) to restore the original aspect ratio. When a widescreen film is presented on television without being expanded, it is said to be squeezed. An unexpanded film print is said to be a squeeze print (the opposite is "flat").

SRI Stanford Research Institute. SRI International owns DSRC, developer of the ACTV schemes.

Static Resolution Detail in a stationary image. Any amount of bandwidth is sufficient for the transmission of HDTV images with high static resolution—even a telephone line; the smaller the bandwidth, the longer it takes to transmit all of the resolution. Therefore, many ATV schemes with reduced bandwidths offer the static resolution of HDEP with limited dynamic resolution, resulting in motion artifacts such as motion surprise.

Standard A set of rules or characteristics defining a particular television system. Some standards (such as those contained in FCC rules and regulations) are mandatory. Most (including those of the EIA, IEEE, and SMPTE) are voluntary. The establishment of a standard often freezes development at a certain level but allows users and manufacturers to deal with a much larger array of products than might be available without a standard. There is currently one U.S. HDEP standard, the ATSC/SMPTE 1,125 scanning-line system. CCIR system E is an HDTV transmission standard, used in France, calling for 819 scanning lines in a 14 MHz bandwidth.

Standards Converter A device for converting signals from one standard to another. Converting between different color schemes with the same scanning structure is called transcoding. Converting between different scanning structures requires line and field interpolation, which usually introduces artifacts. Standards conversion between 525 scanning line and 625 scanning line signals is performed regularly. Conversion from HDEP to either NTSC or a receiver-compatible ATV system will require standards conversion. It may seem that it is more difficult to convert from 1,125 scanning lines to 525 than from 1,050 to 525, but in a pre-filtering converter the difference—if any—may not be large. For dealing with the field-rate difference (HDEP 60 and NTSC 59.94), some HDEP to NTSC conversions are performed by slowing the HDEP recorders to 59.94-field playback. Others are performed through standards converters that periodically omit fields.

Subcarrier An auxiliary information carrier added to the main baseband signal prior to modulation. The most common example in television is the NTSC color subcarrier. Many ATV schemes propose adding additional subcarriers to NTSC.

Sub-channel A transmission path within the main transmission path. Subcarriers are examples of sub-channels, but there are others. Quadrature modulation of the picture carrier provides a sub-channel; so does blanking stuffing.

Sub-sampling Sampling within samples. For example, dividing an NTSC pixel into three or four subpixels is an example of sub-sampling. Some ATV schemes use such pixel subdivision to transmit a high definition image over a sequence of multiple fields or frames, with only one sub-pixel being transmitted per field or frame. The resulting potential artifacts include motion surprise and twinkle.

SuperNTSC An ATV scheme proposed by Faroudja. It combines progressive scanning, pre-filtering, precombing, image enhancement, and gamma correction at the transmission end with complementary processing and line doubling at the receiver. It is both channel-compatible and receiver-compatible and is one of the few ATV schemes that keep an aspect ratio of 12:9.

S-VHS Super VHS, a consumer videotape format offering horizontal resolution somewhat greater than that offered by NTSC broadcasting but allowing component recording and playback without cross-luminance or cross-color artifacts through a four-pin S-Video connection (see reference 26).

S-Video The separate luminance and chrominance (Y/C) connection found on all S-VHS and ED-Beta VCRs and many television sets and cameras, allowing recording and playback of signals without cross-color or cross-luminance.

Sync Buzz A noise containing harmonics of 59.94 Hz, heard on television set speakers under certain signal and transmission conditions. One such condition is the transmission of electronically generated characters of high level and resolution greater than can be carried in NTSC. The ringing resulting when those signals hit an NTSC filter causes the television carrier to momentarily disappear. Since the characters are within a television field, the rate of appearance and disappearance is a multiple of the field rate, 59.94 Hz.

System Gamma The overall light-in/light-out characteristic of a television system, from camera through receiver. In an ideal system, the gamma should be one. In practice, it appears to be about 1.4.

T

T Tele- (as in television) or time.

Taboos Empty channel spaces in the frequency allocation table to which broadcast channels cannot be assigned due to potential interference. The most obvious one is the co-channel taboo: Two different television or radio stations cannot operate on the same frequency in the same geographical area. Other taboos cover geographical spacing for adjacent channels and for "images" (spurious frequencies akin to aliases) that are caused by reception in existing television sets. The taboos effectively knock out much of the UHF television band, so some ATV proponents wonder whether they might be too strict.

T-Axis Time axis of the spatio-temporal spectrum.

TDF Telediffusion de France. A proponent of the French proposals.

Temporal Relating to time.

Temporal Alias An alias caused by violation of the Nyquist limit on sampling in time with frames. The most common temporal alias is in images of spinning wheels that appear to be turning backwards.

Temporal Resolution The finest moments of time that can be perceived in a particular system. It is not the same as dynamic resolution, which is spatial resolution when an image is changing. As an example, suppose a spoked wheel is turning. If the spokes are a blur when the wheel is not turning, the system has poor static resolution; if they are clear, it has good static resolution (for the spokes). If they are a blur when the wheel is turning, the system has poor dynamic resolution and poor temporal resolution. If they are clear when the wheel is turning, the system has good dynamic resolution. If, though clear, they appear to be stationary, or turning in the wrong direction, or turning at the wrong speed, or flashing rapidly in different positions so it is impossible to tell which way or at what speed they are turning (a temporal blur), the system has poor temporal resolution. A great deal of evidence indicates that the human visual system cannot simultaneously perceive high spatial resolution and high temporal resolution.

Thomson Major French electronics firm that recently purchased GE/RCA Consumer Electronics and previously purchased German consumer electronics interests, the latter sometimes referred to as International Thomson. Through its GE/RCA holdings, Thomson is a proponent of the ACTV ATV schemes; through International Thomson, it has proposed progressive schemes. Thomson also sells television production equipment and for a time owned the production equipment branch of CBS Laboratories, then called Thomson-CSF Laboratories.

Time Compression A technique used in many ATV schemes (including all of the MACs) for squeezing a signal of a certain duration into a time period of lesser duration. This effectively multiplies the bandwidth of the original signal by the compression factor. If the higher bandwidth is not available, horizontal resolution is lost. Time compression is most frequently used for color components (which can often afford the resolution loss due to restricted visual acuity) and for widescreen panels (with the resolution loss made up via some sub-channel).

Time Multiplex See Multiplex.

TMC Time multiplex component. An old CBS ATV proposal for delivery via two NTSC-capable DBS channels. One channel would carry a MAC signal of NTSC characteristics; the other would carry additional vertical resolution and widescreen panels. This was the first system to prove that widescreen seams could be rendered invisible.

Toshiba One of the first television set manufacturers to demonstrate an IDTV set. Also a proponent of a widescreen ATV system utilizing high-frequency subcarriers to carry the side panels in a receiver-compatible, channel-compatible signal.

Training Signal A Philips-proposed signal to be used in a two-channel ATV transmission scheme that would alert the receiver to flaws that may have been introduced in the transmission of the second channel so that it can compensate for them.

Transmission Aperture A number used to compare the amounts of light passed through optical systems, such as camera lenses. Transmission aperture takes into consideration both the f-stop (geometric aperture) and the amount of light absorbed or reflected in the optical system.

Transmission Standard A standard to be used for transmitting signals to the home, not necessarily for producing them. The scanning structure of NTSC is identical for both production and transmission, but this need not be the case in ATV schemes. For example, an HDEP standard of 1,125 scanning lines might be used with a transmission standard of 1,050 lines. Standards converters translate one standard into another.

Triad Three colored phosphor dots on the faceplate of a tri-color CRT. Some tri-color CRTs use vertical stripes of different color phosphors or vertically oriented oblong dots. These dots or stripes are the ultimate determinants of maximum horizontal resolution. When the dots are round, they are also the maximum determinants of vertical resolution. The finer the dot pitch, the higher the resolution, since it is not possible to reduce the size of a black-and-white pixel below the size of one triad. Triad spacing also cannot be optimized for all numbers of scanning lines. Thus, a tube optimized for 1,125 scanning lines will not yield optimum performance with a signal of 1,050 scanning lines, or vice versa. Neither black-and-white CRTs nor the three single-color CRTs used in most projection TV sets suffer from these limitations as their faceplates are uniformly covered with a layer of phosphor and resolution is ultimately determined by the size of the electron beam and the projection optics. Picture tubes with striped apertures can deal effectively with multiple scanning rates, but still restrict horizontal resolution to the width of three stripes.

Tri-Scan Term for the technique of sub-sampling each NTSC pixel into three sub-pixels used in the HD-NTSC ATV scheme.

True NTSC A concept of an idealized NTSC that is identical throughout the NTSC world. Unfortunately, the NTSC standards are loose enough to allow various sub-channel schemes, though these schemes may be mutually incompatible. It is possible that some years from now an NTSC television set designed for one form of enhanced NTSC may be receiver-incompatible with transmissions of another form of enhanced NTSC.

TV Lines Measure of resolution. A TV line is either black or white, so two TV lines (one black and one white) form one cycle of spatial resolution. TV lines are often confused with scanning lines. For vertical resolution, scanning lines multiplied by the Kell factor (and, when appropriate, by the interlace coefficient) yield TV lines.

Twinkle A sparkling effect that can be caused by sub-sampling, since the finest detail is transmitted at a rate below the flicker frequency (and sometimes even below the fusion frequency).

Twitter A flickering of fine horizontal edges caused by interlaced scanning. A fine line appearing in only one field is presented below the flicker frequency; therefore, it flickers. Twitter is eliminated in line doubling schemes that change from interlaced to progressive scanning, as most of the IDTV schemes do. Interestingly, twitter was much less of a problem in the early days of NTSC, than it is today, because early cameras and displays didn't have sufficient detail to confine an edge to one scanning line.

UHF Ultra-high frequency, the band from 300 MHz to 3 GHz. In television, UHF refers to a subset of that band, the range from 470 MHz to 890 MHz, once allocated to TV channels 14 though 83. Demands of other transmission services (such as police radios) have eaten into both the lower and the upper reaches of the UHF TV allocations. Taboos eliminate still more channels. Nevertheless, the UHF TV band is seen by many ATV proponents as the most likely place to situate receiver-incompatible and augmentation ATV channels.

Table VIII:
SCANNING LINES PER FRAME

525—NTSC
625—Most non-NTSC broadcast systems
655—Used for electronic cinematography with 24 frames per second
675—EIA industrial standard
729—EIA industrial standard
750—RCA and International Thomson progressive scan proposals
819—CCIR System E (used in France)
875—EIA industrial standard
900—International Thomson progressive scanning proposal
945—EIA industrial standard
1,001—French progressive scan proposal for NTSC countries
1,023—EIA industrial standard
1,029—EIA industrial standard
1,049—Double NTSC with interlaced scanning
1,050—Double NTSC with progressive scanning, French interlace proposal
1,125—ATSC/SMPTE HDEP standard
1,200—French progressive scan proposal for non-NTSC countries
1,225—EIA industrial standard
1,249—Double non-NTSC with interlaced scanning
1,250—Double non-NTSC with progressive scanning
1,501—Early BBC proposal
2,125—Early NHK monochrome system
2,625—RCA electronic cinematography proposal

V

VBI See Vertical Blanking Interval.

Vertical Alias An alias caused by unfiltered sampling in the vertical direction by scanning lines. Vertical aliasing is frequently noticed when reading vertical resolution on a resolution chart. The wedge-like lines become finer and finer until they reach the limit of the vertical resolution of the system, but then they may appear to widen or to change position. This is caused by lines on the chart sometimes falling between scanning lines and sometimes on them. In a properly filtered television system, detail finer than the vertical resolution of the system would be a smooth blur.

Vertical Blanking Interval A period during which the electron beam in a display is blanked out while it travels from the bottom of the screen to the top. It is the black bar that becomes visible when the vertical hold on a television set is not correctly adjusted. The VBI is usually measured in scanning lines. When the VBI is subtracted from the total number of scanning lines, the result is the number of active scanning lines. In NTSC, the VBI has a duration of 20.5 or 21 lines (depending on the field), of which nine lines are devoted to the vertical synchronizing signal that lets television sets know when a field has been completed. The remaining lines have long been used to carry auxiliary information, such as test and reference signals, time code, and encoded text, such as captions for the hearing impaired. Some ATV schemes propose expanding the VBI to accommodate widescreen images by the letterbox technique; some propose using it as a sub-channel for additional picture information. See also Blanking.

Vertical Resolution The amount of detail that can be perceived in the vertical direction; the maximum number of alternating white and black horizontal lines that can be counted from the top of the picture to the bottom. It is not the same as the number of scanning lines. It is the number of scanning lines minus the VBI times the Kell factor (and, where appropriate, times the interlace coefficient).

Vertical-Temporal Pre-Filtering Filtering at the camera or transmission end to eliminate vertical and temporal aliases. When a high line rate, progressively scanned camera is pre-filtered to NTSC rates, the resulting image is not only alias-free but can also be used by an advanced receiver to provide vertical and temporal resolution beyond that normally found in NTSC. The Kell factor of such a system can be close to one.

Vertical-Temporal Sampling Sampling that occurs in every television signal due to individual frames (which sample in time) and individual scanning lines (which sample in the vertical direction). This sampling can cause aliases unless properly pre-filtered.

Vestigial Sideband The vestige of a sideband left after filtering.

VHF Very high frequency. The range from 30 MHz to 300 MHz, within which are found U.S. television channels 2 through 13. VHF television channels seem about as filled as current technology allows, which is why much ATV debate centers on channel allocations in UHF and/or SHF. Some ATV proponents, however, feel that a robust, low-level digital augmentation channel might be squeezed into adjacent VHF channels without interference—perhaps even two such augmentation channels per adjacent channel. If that can be done, every U.S. television broadcaster would be able to have an ATV augmentation channel.

Viewing Distance Distance between an image and a viewer's eyes. In television, the distance is usually measured in picture heights. In film it is sometimes measured in picture widths. As a viewer gets closer to a television set from a long distance, the amount of detail perceptible on the screen continually increases until, at a certain point, it falls off rapidly. At that point, scanning line or triad visibility is interfering with the viewer's ability to see all of the detail in the picture—sort of not being able to see the forest for the trees. The finer the triad or scanning structure, the closer to the screen this point can be (in picture heights). Therefore, high-definition screens allow either closer viewing for the same size screen or larger screens for the same physical viewing distance (not in picture heights). When the effects of scanning lines and triads are reduced, other artifacts (such as a temporal alias of panning called strobing) may become more obvious. From far enough away, it is impossible to tell high-definition resolution from NTSC resolution.

Visible Scanning Lines Normally considered a defect that affects perception of fine vertical detail. Scanning line visibility can also have an apparent sharpness increasing effect, however. See also Sharpness and Viewing Distance.

Visible Subcarrier The most basic form of cross-luminance.

VISTA Visual system transmission algorithm. The NYIT ATV scheme. VISTA is based on the inability of the human visual system to perceive high temporal and high spatial resolution simultaneously. It combines low frame rate, high line rate information with normal frame rate normal line rate information to create a channel-compatible, receiver-compatible signal plus a 3 MHz augmentation channel. Aspect ratio accommodation has been suggested by blanking adjustment, squeeze, and shoot and protect techniques. In spite of the relatively small size of NYIT's research center, VISTA was one of the first ATV schemes to actually be implemented in hardware.

Visual Acuity The amount of detail perceptible by the human visual system. It depends on many factors, including brightness, color, orientation, and contrast. Optimum viewing distance depends upon visual acuity (see reference 28).

VSB-AM See AM-VSB

Table IX: ASPECT RATIOS

:1	:9	Description
1.0	9	Square photographic formats, including Instamatic 126
1.33	12	Existing television, old movies, Pocket Instamatic 110
1.44	13	IMAX film
1.5	13.5	35mm still photographs, proposed for theatrical release
1.61	14.5	Faroudja HDTV proposal
1.67	15	Original NHK proposal, theatrical projection outside the U.S.
1.78	16	ATSC/SMPTE HDEP standard, optimized for shoot and protect
1.85	17	Theatrical projection in the U.S.
2.0	18	Most forms of VistaVision
2.2	20	Some widescreen movie formats
2.35	21	CinemaScope and similar movie formats
2.6	23	Cinerama
2.7	24	Dimension-150, Ultra-Panavision
2.77	25	Dynavision widescreen 3D film format
4.0	36	Polyvision (Abel Gance's *Napoleon,* 1927)

WG-HDEP SMPTE's working group on HDEP.

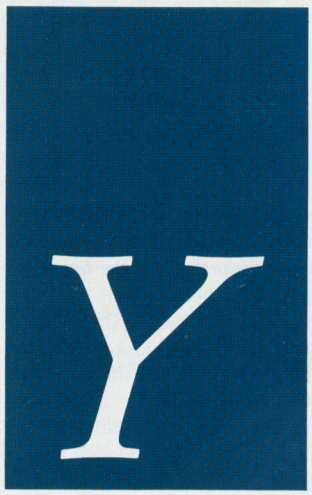
Wideband Relatively wide in bandwidth.

Widescreen An image with an aspect ratio greater than 1.33:1. See Table IX.

Widescreen Panels Additional sections of picture information that can be added to a 1.33:1 aspect ratio picture to create a widescreen image.

World Standard A television standard accepted in all parts of the world. CCIR recommendation 601 is currently the closest there is to a world standard. It is accepted throughout the world, but can be used with either 525-scanning line or 625-scanning line pictures. HDTV 1125/60 Group is attempting to promote its system as a world HDEP standard, but Zenith suggests the same for 3XNTSC, and there are other candidates.

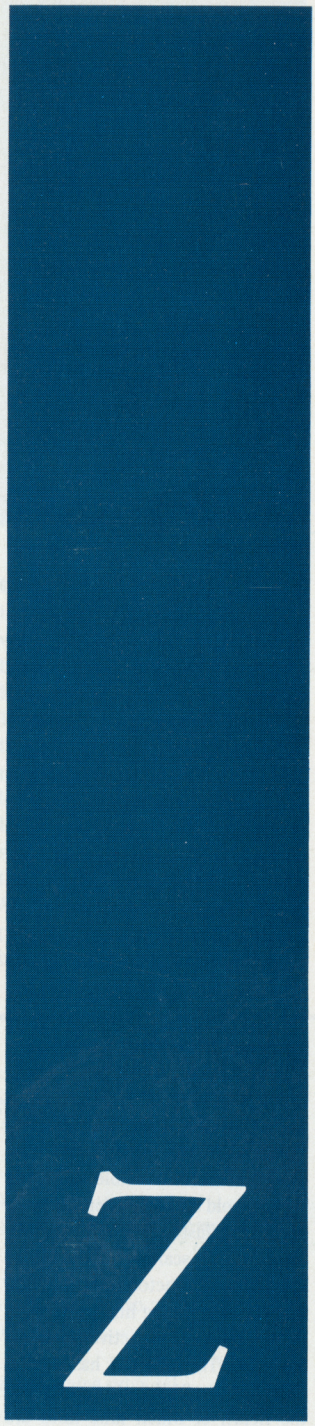
X-Axis The horizontal axis of a graph. When a television signal is examined in one dimension, the x-axis is usually time. When it is examined in three dimensions, the x-axis is usually horizontal resolution.



Y Luminance, so named because it is the y-axis of the chart of the spectral sensitivity of the human visual system.

Y-Axis The vertical axis of a graph. When a television signal is examined in one dimension, the y-axis is usually signal strength. When it is examined in three dimensions, the y-axis is usually vertical resolution.

Y/C Connections Connections between videotape recorders and between videotape recorders and cameras, monitors, and other devices that keep luminance and chrominance separate and thus avoid cross-color and cross-luminance (see reference 29). See also S-Video.



Z-Axis An axis of a three-dimensional graph, which, when printed on a flat piece of paper, is supposed to be perpendicular to the plane of the paper. When a television signal is examined in three dimensions, the z-axis is usually time.

Zenith Major U.S. consumer electronics manufacturer and proponent of the 3XNTSC ATV scheme, also possibly the first organization to suggest pre-combing for NTSC.

Numbers

1:1 Either a perfectly square (9:9) aspect ratio or the field:frame ratio of progressive scanning.

2:1 Either an aspect ratio twice as wide as it is high (18:9) or the field:frame ratio of interlaced scanning.

3D Three dimensional, either as in stereoscopic television (NHK has suggested alternating 3DTV transmissions with HDTV), or more often, when referring to ATV, relating to the three dimensions of the spatio-temporal spectrum: horizontal, vertical, and time.

3-Perf A concept for saving money on film stock by shooting each 35mm frame in an area covered by three perforations rather than four. The savings is more than enough to compensate for switching from 24 frames per second to 30. Three-perf naturally accommodates a 1.78:1 (16:9) aspect ratio and can be easily masked to the 1.85:1 common in U.S. movie theatres. It changes the shoot-and-protect concept of using theatrical film on television, however, from one in which the protected area is extended vertically to one in which the shooting area is reduced horizontally.

3XNTSC A Zenith proposal for an HDEP scheme that would use three times as many scanning lines as NTSC (1,575), but would otherwise retain NTSC characteristics. It is said to allow easy standards conversion to 525- or 625-scanning line systems and to accept material shot in 1,125 scanning lines in a 16:9 aspect ratio without difficulty. 3XNTSC would have 1,449 active scanning lines, 2:1 interlace, a 4:3 aspect ratio, and a bandwidth of 37.8 MHz.

24 Frames Per Second International standard for motion picture film shooting and projection, though film shot for television in 625 scanning-line countries is usually shot at 25 frames per second (even if not, it is transferred to television at 25 frames per second). There are moves afoot in the U.S. to increase the film frame rate to 30 for improved temporal resolution. The ImageVision HDEP system and other electronic cinematography systems use 24 frames per second. RCA once proposed an electronic cinematography system with 2,625 scanning lines (2,475 active), a 2.33:1 aspect ratio, and a frame rate of 23.976023.

25 Frames Per Second Frame rate of television in all countries not conforming to CCIR system M (NTSC). Also the frame rate of film shot for television in those countries.

29.97 Frames Per Second Frame rate of NTSC color television, changed from 30 so that the color subcarrier could be interleaved between both the horizontal line frequency and the sound carrier (see reference 4).

30 Frames Per Second Frame rate of NTSC prior to color. Frame rate of the ATSC/SMPTE HDEP standard. A potential new film standard.

45 Mbps Nominal data rate of the third level of the hierarchy of ISDN in North America. See also DS3.

50 Fields Per Second Field rate of 25 frame-per-second interlaced television.

59.94 Fields Per Second Field rate of NTSC color television.

60 Fields Per Second Field rate of the ATSC/SMPTE HDEP standard.

60 Frames Per Second Frame rate of Showscan and some progressively scanned ATV schemes.

100 Fields Per Second Field rate of some European proposals for a world standard for ATV.

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